Will we ever get back what we have lost? Examining the regulation of ecological restoration across three Australian case studies

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Abstract

Ecological restoration is a practice that seeks to assist the recovery of an ecosystem. It is a practice that has gained significant traction as a response to land degradation, climate change and biodiversity loss across the world and has been recognized as a complement and tool of environmental conservation and management. Despite significant investment in research, regulatory reform and delivery, ecological restoration has been criticized for failing to deliver on its promise to contribute to social-ecological recovery. This thesis explores from a regulatory perspective the provisions for ecological restoration across three case studies in Australia and asks what regulatory arrangements are required for social-ecological recovery. Informed by participant interviews and a multi-level institutional analysis, this thesis found that environmental law and regulation is failing to deliver on its mandate to prevent environmental harm and to facilitate recovery of social-ecological systems. Regulation for ecological restoration is spatially and temporally limited with fragmented regulatory systems that impede recovery across landscapes. The thesis also found that the adoption of adaptive governance characteristics in regulatory systems do assist somewhat in facilitating ecological restoration but ultimately do not address the drivers of land degradation nor clearly articulate and strictly enforce the recovery of social-ecological recovery. Institutional analysis of the regulatory space of ecological restoration revealed that recovery is impeded by regulation that seeks to maintain and facilitate economic development and extraction while simultaneously avoid the negative environmental, social and economic externalities associated with land degradation. In line with an institutional theory of change, this thesis sets out a series of interventions for ecological restoration

regulation that are deliberative and democratic. With 2021-2030 the International Decade of Ecosystem Restoration, this thesis is a timely reminder that without a significant shift to the way in which western states conceive of the environment and regulate environmental concerns, regulatory systems will continue to fail to support ecological restoration, leaving the recovery of life-sustaining social-ecological systems an unrealised aspiration.

Résumé

La restauration écologique est une pratique destinée à aider le rétablissement d'un écosystème. C'est une pratique qui a gagné en popularité en réponse à la dégradation des terres, au changement climatique et à la perte de biodiversité à travers le monde, et a été reconnue comme un complément et un outil de conservation et de gestion environnementale. Malgré des investissements importants dans la recherche, la réforme et la mise en œuvre réglementaire, la restauration écologique a été critiquée pour ne pas avoir tenu sa promesse de contribuer à le rétablissement socio-écologique. Cette thèse explore les dispositifs de restauration écologique d'un point de vue réglementaire à travers trois études de cas en Australie. Elle interroge quelles dispositions réglementaires sont nécessaires pour le rétablissement socio-écologique. Informée par des entretiens avec des participants et une analyse institutionnelle multi-niveaux, cette thèse révèle que les législations et réglementations environnementales ne remplissent pas leurs mandats de prévenir les dommages environnementaux et de faciliter le rétablissement des systèmes socio-écologiques. La réglementation de la restauration écologique est limitée dans l'espace et dans le temps avec des systèmes réglementaires fragmentés qui entravent le rétablissement des écopaysages. Cette thèse révèle également que l'adoption de caractéristiques de gouvernance adaptative au sein des systèmes réglementaires aide quelque peu à faciliter la restauration écologique mais, à terme, ne s'attaque pas aux causes de la dégradation des terres, n'articule pas clairement et ne n'applique pas strictement à le rétablissement socio-écologique. L'analyse institutionnelle de l'espace réglementaire de la restauration écologique révèle que le rétablissement est entravée par une réglementation qui cherche à

maintenir et à faciliter le développement économique et l'extraction, tout en évitant les externalités environnementales, sociales et économiques négatives associées à la dégradation des terres. S'inscrivant dans une théorie institutionnelle du changement, cette thèse propose une série d'interventions pour la régulation de la restauration écologique en concordance avec les processus délibératifs et démocratiques. Avec la Décennie internationale de la restauration des écosystèmes (2021-2030), cette thèse vient rappeler, de manière opportune, que sans un changement significatif de la façon dont les États occidentaux conçoivent l'environnement et réglementent les préoccupations environnementales, les systèmes règlementaires continueront d'échouer dans l'accompagnement à la restauration écologique, faisant de le rétablissement des systèmes socio-écologiques nécessaires au maintien de la vie une aspiration non réalisée.

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Contribution to original knowledge

This work contributes to ongoing scholarship on ecological restoration and regulation by providing insights from on-the-ground ecological restoration practitioners, scholars and regulators.

The following elements are considered original scholarship and distinct:

1. A qualitative assessment of the adoption of adaptive governance characteristics across three regulatory case studies of ecological restoration in Australia. This research also contributes to a scholarship gap as adaptive governance research has generally focused on the emergence of localized, bottom-up governance approaches rather than consideration of state-led, regulatory arrangements.
2. An empirically informed comparative analysis across three regulatory case studies of ecological restoration in Australia. Empirical research on the regulation of ecological restoration is usually focused on discrete industries or activities (mine rehabilitation and closure, marine restoration, restorative agriculture etc), rather than attempting to draw out cross-cutting themes from multiple regulatory case studies. Observations have been made by legal scholars regarding overarching approaches to ecological restoration across the Australian jurisdiction, but this has not (to my knowledge) been supported by empirical research.
3. The application of, and theorizing with, the concept of environmental statehood to the ecological restoration regulatory case studies. This extends the scholarship on the concept of environmental statehood developed by Ioris (2015; 2014), grounding it in empirical data and applying it to the practice domain of ecological restoration.

4. The application of the transformative strategies of Wright (2010) to the regulation of ecological restoration. This approach of Wright's (2010) has been applied in degrowth scholarship (D'Alisa and Kallis 2020), climate justice (Routledge, Cumbers, and Derickson 2018), biodiversity conservation (Massarella et al. 2021) and consumerism (Brown and Vergragt 2016) but not to ecological restoration or the regulation of ecological restoration.

In addition to the original scholarship, this thesis contributes to the emerging empirical literature on ecological restoration law and regulation in Australia (see, for example, Bell-James et al. 2022; Bell-James 2022; Fidelman et al. 2019; Shumway et al. 2021; Unger, Everingham, and Bond 2020; Vivoda, Kemp, and Owen 2019) and the work of emerging scholarship into the application of adaptive governance to ecological restoration (see, for example, Hodge and Adams 2016; 2015). This thesis also contributes to scholarship on the influence of neoliberalism on conservation management, particularly ecological restoration which is an under-explored area (see, for example, Arsel and Büscher 2012; Boon and Prahalad 2017; Elias, Joshi, and Meinzen-Dick 2021; Osborne et al. 2021).

Contribution of authors

Introduction, literature review, discussion and conclusion

Emille Boulot conceived, designed the structure and wrote and edited these sections. The literature review was informed by research undertaken for this thesis, as well as papers written with Joshua Sterlin, Dr Laura Mai, Dr Ben Collins and Dr Katie Woolaston. I also acknowledge their input and the conversations that I had with all of them, which have surely shaped the ideas contained in these sections in certain ways.

Chapter 1

Emille Boulot co-conceived and co-designed the analysis, undertook research and co-wrote and edited the paper.

Professor Akhtar-Khavari co-conceived and co-designed the analysis and co-wrote and edited the paper.

Chapter 2

Emille Boulot conceived and designed the analysis, collected the data, performed the analysis, formulated the findings and wrote and edited the paper.

Chapter 3

Emille Boulot conceived and designed the analysis, collected the data, performed the analysis, formulated the findings and wrote and edited the paper.

Chapter 4

Emille Boulot conceived and designed the analysis, collected the data, performed the analysis, formulated the findings and wrote and edited the paper.

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List of figures and tables

List of abbreviations

CAR	Comprehensive, adequate and representative
CAS	Complex adaptive system
CBD	*Convention on Biological Diversity*
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DES	Department of Environment and Science
DNRME	Department of Natural Resources and Mines and Energy
DR	Department of Resources
EIA	Environmental impact assessment
eNGO	Environmental non-government organization
EP Act Qld	*Environmental Protection Act 1994* (Qld)
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999 (Cth)
FPA	Forest Practices Authority
FPC	Forest Practices Code
FPO	Forest Practices Officer
FPP	Forest Practices Plan
IPBES	The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change

IUCN	International Union for Conservation of Nature
MNES	Matters of national environmental significance
MR&C	Mine rehabilitation and closure
NGO	Non-government organization
NRM	Natural resource management
NRS	National Reserve System
NSW	New South Wales
PRC	Progressive Rehabilitation and Closure
PRCP	Progressive Rehabilitation and Closure Plan
Qld	Queensland
REDD+	Reducing emissions from deforestation and forest degradation in developing countries
RFA	Regional Forest Agreement
RMP	Rehabilitation management plan
SDG	Sustainable Development Goal
SER	Society of Ecological Restoration
SERA	Society for Ecological Restoration Australasia
STT	Sustainable Timbers Tasmania
Tas	Tasmania

TEK	Traditional ecological knowledge
TO	Traditional owner
UNFCCC	*United Nations Framework Convention on Climate Change*

Introduction

Biodiversity loss, anthropogenic climate change, habitat loss and ecosystem decline and collapse have all led to concerns about the future of social-ecological systems[1] on Earth. Ecological restoration has gained significant traction as a response to these intersecting and interconnected problems and is part of a suite of reactive environmental strategies to manage the natural environment[2], once a social-ecological system has been damaged to a point that it requires active input to assist in its recovery. Ecological restoration is a practice that seeks to assist 'the recovery of an ecosystem that has been degraded, damaged or destroyed' and 'aims to move a degraded ecosystem to a trajectory of recovery that allows adaptation to local and global changes, as well as persistence and evolution of its component species' (Gann et al. 2019, s7). *Restoration* is therefore a process; *recovery* is its aim. Ecological restoration is informed by both the science of restoration ecology and social acceptability (Higgs 2003), with regulation and governance arrangements integral to its definition, operation and success (Telesetsky 2013; Richardson and Lefroy 2016; Wyborn and Dovers 2014).

Despite significant investment in research, regulatory reform and delivery, evaluative research suggests that ecological restoration is not delivering on its promise to contribute to ecosystem recovery (Cooke, Bennett, and Jones 2019; Bullock et al. 2011; Jones et al. 2018;

[1] Social-ecological systems are integrated and interdependent complex systems. As a concept, social-ecological systems do not delineate between the cultural and natural, but rather recognize these systems as dynamic and relational (Berkes and Folke 1998; Biggs et al. 2021).

[2] The terms 'environment' and 'nature' are used in their usual understanding throughout this thesis, while also acknowledging that these terms perpetuate certain dualist and colonial conceptualizations in which the 'human' or 'social' is considered separate to non-human natures and entities (Cudworth and Hobden 2013).

Suding 2011). This thesis presents three regulatory case studies from Australia, and by using various social and legal methods, asks what regulatory frameworks are required for socio-ecological recovery. This thesis explores the regulatory and institutional arrangements for ecological restoration, evaluates the adoption of adaptive governance principles in ecological restoration regulation, investigates the regulatory drivers of ecological restoration before making a number of recommended reforms to the regulatory arrangements for ecological restoration.

The relationship between regulation and ecological restoration practice is an emerging field of research with scholarship that has made significant normative and theoretical contributions (see amongst others: Akhtar-Khavari and Richardson 2019; Richardson and Lefroy 2016; Richardson 2016; Telesetsky et al. 2016; Telesetsky 2013; Hayes 2002; Palmer and Ruhl 2015; Aronson et al. 2009), with some emerging empirical research, particularly relation to mine rehabilitation (see Mills 2022; Vivoda, Kemp, and Owen 2019; Unger, Everingham, and Bond 2020; Bainton and Holcombe 2018; Bond and Kelly 2020; O'Faircheallaigh and Lawrence 2019; Kung, Everingham, and Vivoda 2020), marine restoration (Shumway et al. 2021; Bell-James and Lovelock 2019; Bell-James 2022) and wetland restoration (Gardner and Jensen 2016). This thesis aims to contribute to this nascent area of research and is novel in that it undertakes a comparative case study analysis of ecological restoration of three different regulatory regimes across Australia to draw out more generalisable findings. Through an interdisciplinary methodology, this thesis considers the regulatory drivers of restoration to analyse the relationship of the state to land degradation and recovery, and sets forwards recommendations for reform that deliberately consider this relationship between the state and recovery. The methods employed are

empirical, multi-disciplinary and appropriate to the research of complex, adaptive systems and the explicit consideration of ontological questions or questions regarding social realities, an approach necessary for any exploration of the ideologies, values and norms of regulation and institutions.

This thesis has five key research objectives:

1. To examine how traditional environmental law and regulation responds to the high levels of uncertainty present in complex, adaptive socio-ecological systems.
2. To investigate the regulation of ecological restoration.
3. To determine whether an adaptive approach to regulation is an appropriate response to high levels of uncertainty in complex, adaptive socio-ecological systems.
4. To investigate the regulatory drivers for ecological restoration and consider the effectiveness of regulatory institutions for ecological restoration.
5. To identify important elements for the design of regulatory frameworks that can facilitate recovery.

Following a comprehensive literature review, Chapter 1 explores the ways in which environmental regulation largely struggles to capture the complex relations in the transformations of social and ecological systems. It examines the tendency of environmental regulation to approach environmental management in a predominantly efficiency-driven, transactional, command-and-control way, which prioritizes front-end processes to predict and assess environmental harm in a balancing act with economic growth, national interest and social stability. Informed by both the tradition of legal positivism and positivist interpretations of environmental realities, this chapter finds that environmental regulation

continues a particular ontological framing in which environmental regulation reinforces a constructed dichotomy between the spheres of the *anthropos* and the natural world. Chapter 1 argues that environmental regulation is well suited to maintaining the status quo by protecting private property, national statehood, risk and liability management, and fostering predictability and stability, but ill-suited to governing the omnipresent, uncertain, pervasive and complex 'thing' that is the environment. This poses significant challenges for the regulation for ecological restoration, which is a complex social-ecological process. Scholarship to date has argued that the regulation and governance of ecological restoration should be guided by adaptive and reflexive processes. Chapter 1 explores this scholarship and develops links between complexity science and regulation to conclude that regulatory frameworks for ecological restoration require normative approaches that seek to add complexity to systems. While the concept of adding complexity to a system has been addressed in the existing literature, this chapter brings together discussions of the institutional and regulatory significance of this concept and considers its applicability to the practice of ecological restoration.

Chapter 2 seeks to investigate the hypothesis proposed in Chapter 1: that social-ecological recovery improves with regulation that supports increasing social-ecological complexity. Significant scholarship has argued that the regulation and governance of ecological restoration should through the application of adaptive and reflexive processes. Drawing on qualitative research with 37 study participants, Chapter 2 undertakes a comparative case study analysis of three regulatory case studies to consider the relationship between recovery of socio-ecological systems and regulation that adopts adaptive governance elements. Case Study 1 examines mine rehabilitation and closure (MR&C) regulation in Queensland which

aims to remediate or rehabilitate landscapes for post-mine land use. Case Study 2 examines forest restoration regulation in Tasmania which aims to initiate native recovery. Case Study 3 examines landscape restoration regulation across Australia which generally aims to ensure the partial or full recovery of native ecosystems. The case studies are analysed to determine the extent to which they have adopted four key characteristics of adaptive governance to query whether adaptive regulation is assisting social-ecological recovery. Through careful analysis of the collected data, Chapter 2 concludes that regulation which supports increasing complexity in social and ecological systems goes some way to facilitating recovery; however, ongoing institutional (including regulatory) barriers remain which prevent either the adoption of adaptive approaches or prevent the full recovery of systems.

Chapter 3 examines the institutional barriers to recovery through a multi-level institutional analysis of the three case studies (MR&C; forest restoration; landscape restoration). This chapter sets out in some detail the institutions, the regulatory frameworks, regulatory drivers and effectiveness of the three regulatory case studies. In dialogue with institutional theory, this chapter argues that the institutional arrangements that regulate ecological restoration largely seek to maintain and facilitate economic development and extraction, while simultaneously seeking to avoid the negative environmental, social and economic externalities from extraction. Chapter 3 finds that regulation for ecological restoration has increasingly adopted a neoliberal approach to the regulation of social-ecological systems, with regulatory responses that monetize ecological restoration and aim to include environmental goods and services within the market.

Finally, Chapter 4 analyzes the collected data and sets out regulatory design and reform recommendations that contribute to recovery. This chapter adopts an institutional theory of

change which focuses on regulatory interventions that implicitly or explicitly challenges the current institutional arrangements that express a neoliberal approach to regulation. This chapter adopts Wright's (2010) typologies of system transformation strategies of ruptural (revolution), interstitial (parallel systems) or symbiotic (compromise within the dominant political-economic). Chapter 4 proposes a number of regulatory reforms in line with Wright's (2010) typologies that are grounded in the collected data. Findings include the need to identify and target the underlying drivers of land degradation in the development of regulatory frameworks; develop statutory objectives that prioritize social and ecological wellbeing; governance arrangements that allow for local community engagement and place-specific regulatory arrangements; and co-productive governance, autonomous regulators and regulation that are temporally and spatially aligned with social-ecological systems. Key themes are then explored in some further detail in the discussion and are considered in light of the international UN Decade of Ecosystem Restoration.

Law and regulation is, fundamentally, an expression of the nature of human community, relations with the more-than-just-human community and their ordering. Recognising this, the incorporation of ontological questions and the investigation of social realities forms a significant part of this thesis. An adaptive theory model of research was designed to facilitate such ontological considerations (Layder 2021; 1998) and the research question (What regulatory frameworks are required for socio-ecological recovery?) is answered through the use of multiple strategies and methods. These strategies and methods are detailed in each individual chapter.

Comprehensive review of relevant literature

Given the interdisciplinary nature of this thesis, the literature presented in this review is necessarily incomplete: it canvasses critical environmental law and governance, environment and conservation management, political ecology, sustainability studies and social sciences related to ecological restoration and the law and regulation for ecological restoration. The literature review is therefore organized to provide a more detailed description of the literature presented in the thesis chapters. It is presented in five parts. *Part 1: Problem framing* reviews literature relevant to the problem this thesis investigates: the failure of existing environmental law and regulation to manage or prevent environmental decline. It includes a comprehensive account of the relationship between law and nature and the problematizing influence of complexity. *Part 2: Ecological restoration and its regulation* introduces the practice of ecological restoration and reviews the literature which focuses on its definition and social, governance and regulatory elements. Part 2 then turns to the literature on adaptive governance, an emerging and recommended approach for the management and regulation of ecological restoration. *Part 3: The neoliberal state and the regulation of social-ecological systems* delves into the literature on neoliberalism and how it influences and structures regulatory systems for environmental management. *Part 4: Transformation and theories of change* reviews the literature on transformation and transition, with a focus on institutional and state transformation. *Part 5: Some further notes on the adaptive theory model of research* details the adaptive theory model which underpins this thesis.

Part 1: Problem framing

Global environmental change

Biodiversity loss, anthropogenic climate change, habitat loss and ecosystem decline and collapse have all led to concerns about the future of life on Earth. Some scholars call this 'state shift' in the Earth's bio-geo-ecosystems 'the Anthropocene' due to the influence of human activity and human control on these systems (Crutzen 2002; Zalasiewicz et al. 2010). Steffen et al. (2005) write that earth systems have entered into 'no-analogue' states, as earth systems exhibit conditions not present within the Holocene. Numerous reports detail environmental systems in decline worldwide (Rockström et al. 2009; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services 2019; IPCC 2022; UN Environment 2019) and within Australia (Cresswell, Janke, and Johnston 2021; Samuel 2020). Zalasiewicz et al. (2010, 2231) write that, 'The Anthropocene represents a new phase in the history of both humankind and of the Earth, when natural forces and human forces became intertwined, so that the fate of one determines the fate of the other. Geologically, this is a remarkable episode in the history of this planet'. Hoffman and Jennings (2015, 9) concur, arguing that the Anthropocene is more than just the recognition of geological shifts, but rather 'represents an emergent awareness of a fundamental change in the intellectual, cultural, and psychological conceptions of who we are as humans and how we relate to the world around us'. These broader ontological questions have been picked up by the many science technology studies and legal scholars, such as Latour (2004), Grear (2017; 2015), Haraway (2015), Vidas et al. (2015) and Kotzé (2017), who argue that the social-ecological problems which characterize the Anthropocene are existential problems that derive from the characteristics of the relationship between humans and the more-than-human.

There is, however, some criticism of the term. Authors such as Stirling (2015, 57) note that definitions of the Anthropocene are often made in reference to human control of the natural world which assumes an 'undifferentiated human 'we''. With the roots of the crisis having been closely linked to modernity and capitalism (De Lucia 2017), alternative terms such as 'Capitalocene' (Moore 2017), 'Plantationocene', 'Cthulucene' (Haraway 2015) and 'Civilicene' (Sterlin 2019) have been put forward in an effort to acknowledge the conceptual limitations of the Anthropocene and to describe more accurately the manner in which the narratives of industrial capitalism, colonialism, and civilization shape this new geological epoch. As with other environmental issues, the distribution of responsibility and harm is uneven and inequitable. Those least responsible for environmental harms (such as pollution, climate change and biodiversity collapse) generally suffer the most. Terms such as 'environmental racism' (Bullard 1990), 'environmental justice' (Martinez-Alier et al. 2016; Cutter 1995; Buckingham and Kulcur 2009) and 'toxic colonialism' (Reed 2009) recognize and describe this uneven distribution of socio-ecological benefit and harm.

Law, regulation and nature

Law and regulation refer to a formal system of rules, usually enforced by an agency of the state which sets boundaries on behaviour (Baldwin, Scott, and Hood 1998, 3). The distinction between law and regulation is, therefore, murky. Within common law countries, 'law' is generally assumed to refer to both judge-made law and legislation (Creyke et al. 2021), whereas 'regulation' usually refers to legislation, delegated regulation and sometimes government policy by extension. But regulatory theory and research, like legal research, is

diverse. Scholars have sought to broaden the definition of regulation by recognizing that 'regulation' occupies a space in which multiple actors are engaged in regulating each other—a space which enacts and exhibits power relations (Parker and Haines 2018; see also Baldwin, Cave, and Lodge 2011; Levi-Faur 2011). Nonetheless, law and regulation will be used somewhat interchangeably throughout this literature review, unless the literature refers only to issues relating to law or regulation specifically.

There has been significant critique of the way in which law and regulatory systems relate to the non-human. Much of this critique is dedicated to the ways in which law has 'othered' nature. This ontological separation results from what feminist scholars have called normative constitutive dualisms, where one side of the dualism is 'more than', deciding who and what has rights, the other side is a resource for the use and disposal of the subject (Plumwood 2003). Moore argues, for example, that, 'These exclusions correspond to a long history of subordinating women, colonial populations, and peoples of color' (2016, 2). It has also significantly affected the way in which law approaches nature. Within common law and other Western legal traditions, law separates nature from social and cultural contexts, thereby creating a resource empty of purpose and meaning for extraction and resource development (Grear 2017; Kotzé and French 2018; Vermeylen 2017). The physical world becomes limited to ideas of property and ownership (Freyfogle 1993; Bentham 1931), with private property and corporate rights generally trumping any environmentally informed encroachment upon them (Bartel and Graham 2019).

The issue here is not so much the dualisms themselves, but the resulting hierarchical, internalized and institutionalized relations of power in Western development (Escobar 2016; Kolinjivadi 2019; Plumwood 2003). 'Legal', as Escobar (2015, 19) writes, 'signal[s] a

self-serving set of rules that imperialize the desires of the powerful'. This fundamentally structures the very horizon of possibilities for who and what have legal rights and legal subjecthood. Law has been criticized for excluding the non-human from its subjecthood. Naffine (2009) argues that there is an often-unconscious acceptance of the conceptualization of the legal subject and its conceptual or moral problems. She holds, however, that this acceptance is predicated upon a 'poorly developed' conceptualization of the legal subject outside the study of corporations law, and points to centuries of intellectual disagreement and confusion as to the nature of the legal person (Naffine 2009; 2003). This diversity and confusion aside, an examination of the commonly construed Western legal subject, Grear (2011b) argues, reveals some interesting and revealing underlying core characteristics that bear only a rarefied resemblance to the human person. The legal subject is not a natural being, but rather a legal construct—a formal holder of rights and duties (Naffine 2009), one informed and dependent upon many non-legal considerations (Dewey 1926). These assumptions and characteristics of the legal subject have been significantly informed and based upon the dominant political philosophy of liberalism, resulting in a 'paradigmatic liberal legal subject [that] is a socially decontextualized, hyper-rational, wilful individual systematically stripped of embodied particularities in order to appear neutral and, of course, theoretically genderless, serving the mediation of power linked to property and capital accumulation' (Grear 2011a, 44). Grear argues that this 'quasi-disembodied liberal legal person emerges as an ideological construct intimately related to capitalism', yielding 'not a human being, but a construct remarkably similar to the corporate form' (Grear 2011b, 30). Liberal legal rationalism thus erases any subjecthood which is not dependent upon a framing of the rational liberal subject:

> '[e]conomic man' or 'juridical man' were abstractions from real people emphasising one side of human life – the ability to reason and calculate – at the expense of every social circumstance that actually brings individuals to reason and calculate in particular ways (Norrie 1993, 23).

This 'strategic excision', as Grear calls it (2011b, 26), includes not only the social context but extends to the ecological in this continuing process of constitutive dualisms. Through the universalist nature of the liberal subject, there results a displacement between what the law considers a normal, reasonable subject and what it does not, with the latter becoming the object of law. The subject is decontextualized from the object with the object at the disposal of the subject: from 'Plato to Descartes, the scene was set in which body/women/emotion/nature coalesced into that which was rightfully governed by mind/men/reason/culture as the basis for the development of civilised society' (Bottomley 2002, 134–35).

Environmental law and regulation

Law approaches nature through the nebulous discipline of environmental law. There are many and diverse definitions of environmental law. It is a legal domain that seeks to keep pace with environmental issues and problems which interact across multiple scales and across different social activities and areas of regulation (Godden, Peel, and McDonald 2018). Emerging in the late 1960s and 1970s, environmental law was recognized as a more cogent discipline that aimed to respond to the rise in environmentalism and the need to protect 'the environment' from human degradation (Tarlock 2004). In contrast to other areas of law,

environmental law arose more in legislation and regulation rather than in the common law or the Western legal tradition (Tarlock 2004; see also Fisher 2013; M'Gonigle and Takeda 2013). This raises questions about the integration of environmental law into law more broadly, as well as the content and legitimacy of the discipline. It is a deeply contested space, in which identifying actors, interests, values, rights and obligations is fraught with difficulty (Fisher 2013). Scholars also ask whether a conventional boundary for a discipline is necessary or useful for a topic like environmental law, which is contingent upon broader social-political-ecological contexts (Godden, Peel, and McDonald 2018). Definitions of environmental regulation are similarly diverse. Environmental regulation, Fiorino (2006) argues, is concerned with rules and deterrence of particularly polluting behaviour and compliance with those rules, but regulation has developed in this area to also include market mechanisms that signal and reward appropriate behaviour.

There is significant criticism of the inability of Western, liberal environmental law to truly address the conditions of the Anthropocene (see for example Kotzé 2017; Grear 2017; 2013; Grear and Grant 2015; Philippopoulos-Mihalopoulos 2011b; Tarlock 2004; Ruhl 1996; Garver 2019; Woolaston and Akhtar-Khavari 2020; Wood 2009). Such criticisms emerge from critical environmental law, which questions environmental law's epistemological, ontological, axiological and material problematics, and the manner in which environmental law presents itself as a techno-legal tool that applies environmental sciences (De Lucia 2017; Philippopoulos-Mihalopoulos 2011b; 2011c). Critical environmental law suggests that the failure of environmental law to prevent environmental degradation has been due to the ontological and epistemological approaches of the legal system itself. As Lövbrand et al. (2015, 214) state, the 'fundamental challenges to societal organization posed by the

Anthropocene are, paradoxically, to be countered by many of the same institutions that have allowed the recent human conquest of the natural world'.

Green legal theory similarly seeks to identify the ways in which environmental law perpetuates and extends environmental problems. It also seeks to overcome the deep contradictions in environmental law to pursue systemic re-formulations beyond liberal environmental law (M'Gonigle and Takeda 2013). Emerging jurisprudence such as ecological law (Anker et al. 2021; Garver 2020; 2019), earth system law (Kotzé 2019; 2020; Kotzé and Kim 2019) and earth jurisprudence (Burdon 2015; 2011; Koons 2011; Maloney and Burdon 2014) make similar critiques and seek to establish principles for legal and regulatory systems that support human and nature wellbeing. Critiques of environmental law are not limited to national legislation. Natarajan and Khoday (2014) critique international law for the manner in which it describes nature as a resource for economic development, with environmental degradation as an economic externality, and the deeply inequitable distribution of harms and benefits across the global north and south. They write:

> international lawyers have helped normalize a world-view where nature is understood predominantly as a natural resource, where humanity is at the centre of the environment and privileged above all else, where progress is defined by our degree of control over nature, and where this capacity to control is believed to be limitless (Natarajan and Khoday 2014, 586).

Legal anthropologists have made similar claims linking international environmental law and environmentalism to modernity (Argyrou 2005).

From an ecological regulatory theory perspective, Parker and Haines (2018, 140) argue that the dominant regulatory approach to environmental management is an instrumentally rational approach. Under this approach, regulation is 'designed to intrude as discretely and narrowly into (what is considered as inherently beneficial) business activity as possible'. Regulation's role is to fix market failures and address environmental harms as they arise, with a focus on 'red-tape' reduction. Instruments are piecemeal and do not address systemic problems. In response, Parker and Haines (2018) put forward an agenda for ecologically rational regulation to ensure that regulation is consistent with maintaining life, and that regulatory systems promote diverse regulatory approaches and are systemic in their operation to develop solutions to intersecting and overlapping social and ecological challenges.

Epistemology of environmental law and regulation: what role for environmental sciences?

Environmental science is commonly accepted as the epistemology of environmental law (Philippopoulos-Mihalopoulos 2011). Environmental decision-making and policy requires knowledge about the existence and magnitude of the problems, the actions and the actors that are causing the problems, and potential solutions (Mitchell 2009). Scientific research and knowledge can provide answers to these questions and has been involved in environmental governance for over forty years (Jabbour and Flachsland 2017). The distinction between science (or knowledge) and environmental law and policy has been criticized, however, for being artificial. Leith et al. (2014, 162) write that the boundaries

between science and policy 'are blurred and continually renegotiated', while Philippopoulos-Mihalopoulos (2011a, 4) writes, 'There is no longer a clear-cut boundary between environmental law and … science … environmental law is constantly internalising scientific findings, correctly or incorrectly, and acts upon them. Science … is part of environmental law'.

Environmental governance and management have also been criticized for what Code (2006, 8–9) calls an 'epistemological monoculture'. This mono-epistemology continues the assumption that the natural can be manipulated, controlled and managed to ensure ongoing resource extraction (Adelman 2015). Such positivist interpretations of law have resulted in norm setting that is self-referential and draws upon a limited disciplinary research approach (Kotzé and Kim 2019; Pedersen 2018; Fisher et al. 2009). In the framing and construing of the environment, legal systems draw upon empirical evidence and the knowledge of a technical and 'expert' class to manage and predict environmental outcomes through the application of risk management frameworks. This results in the conversion of inherent ecological uncertainties into numericized probabilities, with Jasanoff (1999) identifying this approach as the bedrock of environmental regulation across most industrial states since the early 1970s. The 'environment' within environmental law is reduced to constitutive parts (such as air, water and soil), thereby diminishing the complexity of socio-ecological systems to make them 'epistemically legible to empirical eyes, and manipulable to Modernist hands, separating mind from matter, culture from nature, and the human from the non-human' (Anker 2017, 191; see also Escobar 2016; Jenkins 2000). Agrawal's (2005) in-depth ethnographic study of local communities in India illustrates this point by demonstrating how

systems of knowledge, institutions and power shape the extension of governmentality to the natural world.

Risk assessment processes rely heavily upon positivist conceptualizations of science and associated bureaucratic-rationalistic policy (Goodie 2012; Jasanoff 1999), establishing what Rutherford (1999a, 56) calls a form of 'regulatory ecological science [that] does not so much describe the environment as both actively constitute it as an object of knowledge and, through various modes of positive intervention, manage and police it'. Scientific evidence becomes 'a pedestal on which a presumption rests for the *comprehension* of risk' (Philippopoulos-Mihalopoulos 2007, 132). Causation under this framework is generally viewed as linear and mechanistic, which can result in partial and selective risk assessment models (Jasanoff 1999). Failure to manage and control natural and social processes and risks is due, in this view, either to a lack of knowledge or competence or to a lack of political will (Jasanoff 1999). Drawing upon Beck's (1992) concept of the 'risk society', Pellizzoni (2004) argues that risk, as a concept, arises in relation to an ontology that takes a mechanistic and manipulative approach to nature and views human individuals as autonomous, free and rational. Risk, however, Jasanoff (1999, 137) argues, cannot be perceived simply as the probability of harm, but rather the 'embodiment of deeply held cultural values and beliefs … concerning such issues such as agency, causation, and uncertainty' with state-led risk assessment frameworks 'implicitly empower[ing] ... some people as experts and exclud[ing] others as inarticulate, irrelevant or incompetent'. Risk discourses also result in a human-nature relationship bound by the language of risk and security and enacted through risk minimization processes (Rutherford 1999b, 116).

The process by which science informs environmental policy generally follows the 'linear' model (Pielke 2007). This model assumes problem-identification to problem-solution processes are conducted through linear, rational and top-down approaches (Wesselink et al. 2013). Knowledge flows from 'basic research to applied research to development and ultimately societal benefits' and it is assumed (particularly by the scientific community) that consensus on science will compel consensus in decision-making and policy responses (Pielke 2007, 12). This model also assumes a clear delineation between objective science to inform decision-making and subjective values. Scientists in this process are considered apolitical and speak truth to power (Pielke 2007; Beck 2011). This approach has been criticized as suitable only for very simple problem contexts, whereas most environmental governance and decision-making tends to take place in complex, uncertain and controversial contexts with a multitude of legitimate perspectives and conflicts over epistemologies, interests and values (Jasanoff 1999; Funtowicz and Ravetz 1993). Application of the linear model results in a limited ability to recognize and integrate environmental complexity (Koetz, Farrell, and Bridgewater 2012) and potentially knowledge hegemonies where scientific knowledge is used to support embedded political agendas (Wesselink et al. 2013). Technical knowledge in this model is promoted as objective, true, rational and sufficient in comparison to local or Indigenous knowledge, which might be portrayed as subjective and irrelevant. To counter this, there has been a move away from reductionist approaches to knowledge incorporation towards more inclusivity at the knowledge-to-policy interface (Nursey-Bray and Jacobson 2014; Nursey-Bray et al. 2014; Innes and Booher 2004).

The inclusion of traditional ecological knowledge (TEK) in the knowledge interface is one example of this shift, as colonial states increasingly face demands to undertake consultation

with, if not obtain consent from, Indigenous peoples in the environmental governance of their territories, often with the inclusion of TEK (Nadasdy 1999). The inclusion of TEK within environmental law fundamentally redefines what is considered 'the environment' (Kimmerer 2011). These processes of consultation and consent have, however, generally been shown to be deficient (Meadows, Annandale, and Ota 2019; O'Faircheallaigh and Lawrence 2019; Barbour and Schlesinger 2012). TEK is often only accepted when framed as an archive that is in compliance with rationalist scientific knowledges (Whyte 2013), rather than consideration of the relationality found at the centre of Indigenous ontologies and expressions of TEK (McGregor 2004). It has been argued that the inclusion of TEK in environmental regulation can function more as a political tool to co-opt opposition, to silo Indigenous knowledge and therefore reinforce the power of the State over Indigenous peoples and their lands than as a genuine inclusion of its relationality (Tully 2018). The management of the environment or natural resources is, therefore, more concerned with the governance of people than 'the natural' per se and is carried out along hierarchical and structurally unequal lines (Boulot and Sterlin 2021).

Recognising complexity: science, law and social-ecological systems

As noted above, liberal environmental law and regulation have been critiqued for conceptualizing 'the environment' in line with an ontology that necessitates and privileges technical scientific knowledge and a belief in control (Adelman 2015). Recently, the rise of an ecological narrative in which humans are recognized as a part of the environment (which itself has complex interactions and relationships between its subjects) presents challenges

for environmental law (see for example Ruhl 1996; Kotzé 2017; Philippopoulos-Mihalopoulos 2011b; Ebbesson 2010; Kim and Bosselmann 2013). Findings from complexity and systems science show that natural systems operate far from equilibrium, with uncertainty, instability and variability key aspects of these systems (Steffen et al. 2005; Chaffin and Gunderson 2016; Holland 2006; 2006; Kovacic 2017; Janssen 1998; Levin 1999; Mitchell 2009).

Key to these complex systems is collective behaviour that is more than the sum of the behaviour of the individual parts (Newman 2011; Mitchell 2009). While a system might have rather simple, deterministic rules, interactions become complex when the rules produce non-linear relationships, leading to emergent behaviour; that is, behaviour that is not implicit in the parts of the systems (Mitchell 2009). Emergent behaviour can support system identity and functions—a property known as self-organization (Kim and Bosselmann 2013). A complex system is also one that cannot be captured using a single perspective (Funtowicz et al. 1999; Munda 2004), which means that the act of observation is not a neutral and objective pre-analytical step. Questions of what and how to observe a complex system become crucial analytical decisions, fundamentally determining the representation of the system (Kovacic 2017).

In addition to notions such as emergence, non-linearity, unpredictability, autopoiesis, and adaptation, uncertainty is central to complex systems (Funtowicz and Ravetz 1994). The uncertainty of complex systems has been described as radical: 'Uncertainty appears here in a dynamic context, in which the passage of time is crucial. The future cannot be anticipated by a fully reliable probabilistic estimate because *the future is yet to be created*' (Dequech 2000, 48). Radical uncertainty applies to circumstances in which an event may occur in the

future but cannot yet be imagined in the present. Probabilities therefore cannot be applied to such events. Radical uncertainty demonstrates that 'some relevant information *cannot be known, not even in principle*' when making decisions (Dequech 2000, 48). As Dupuy (2004, 80; as cited in Tallacchini 2005) writes:

> The key notion here is that of informational incompressibility, which is a form of essential unpredictability. In keeping with von Neumann's intuitions on complexity, a complex process is defined today as one for which the simplest model is the process itself. The only way to determine the future of the system is to run it: there are no shortcuts. This is a radical uncertainty.

Building on the concept of a complex system, a complex adaptive system (CAS) is simply defined as a complex system which is adaptive. The line between a complex system and a CAS is blurry, however. While a complex system can display some adaptive behaviour, a CAS has the ability to adapt to changes in its external environment as a result of experience through conditional action and anticipation (Kauffman 1995; Levin 1999). A CAS also exhibits coherence under change (stable disequilibrium) (Holland 1995; 2014; Bak 1996) and interacts and develops over multiple temporal and spatial scales (Holling, Gunderson, and Ludwig 2002). A CAS is also said to be resilient, referring to 'the capacity of a complex system to remain within a regime in the face of external perturbations and/or internal change' (Garmestani and Benson 2013, 9).

An ecosystems can be considered a CAS (Holland 1995). Lenton and van Oijen (2002) and Steffen et al. (2005) even extend complexity science and the CAS definition to the Earth as a whole, as they note that the Earth's biotic components sustain diversity (populations), localized interactions (ecosystems), and autonomous selection processes (natural selection).

Complexity theory has also been extended from natural systems to social constructs (such as legal systems) which demonstrate their own complexity and adaptiveness in the face of disturbance (Ruhl 1996; 1997; 2008; Cudworth and Hobden 2013).

Responding to complexity from law and regulation

Complexity raises significant issues for law and regulation. Attributes of complex systems, such as self-organization, emergence, non-linearity, scale, uncertainty and feedback, all problematize the positivist understanding of law. Legal certainty does not correspond neatly with the uncertainty and unpredictability of social-ecological systems (Allen et al. 2011; Garmestani, Allen, and Cabezas 2008); Pellizzoni (2004) suggests radical uncertainty can increase in response to attempts to command and control the 'natural world'. As Holling and Meffe (1996, 332) observe:

> Policies and management that apply fixed rules for achieving constant yields independent of scale (e.g., constant carrying capacity of cattle or wildlife or constant sustainable yield of fish, wood, or water) lead to systems that gradually lose resilience-systems that suddenly break down in the face of disturbances that previously could be absorbed .... Ecosystems are moving targets, with multiple potential futures that are uncertain and unpredictable.

Under conditions of uncertainty, the probabilities relating to alternative risk assessments can only be quantified. The probabilities must also be limited by the methods and models of science itself (Goodie 2012; Wynne 1992). Conditions of uncertainty—inherent to the scientific method (Knaggård 2014), CAS and the lack of coherence between scientific

understandings (Sarewitz 2004)—seemingly 'challenge the reliability of the decision-making process' (Tallacchini 2005, S648) as it becomes evident that social-ecological systems cannot be controlled using rational approaches.

Despite such profound implications for the legitimacy of institutional structures of environmental law and governance, as well as implications for the liberal conception of the social contract (Pellizzoni 2004), legal illusions of concepts such as 'control' of the natural world and 'stability' remain a prominent part of international and national norms (Philippopoulos-Mihalopoulos 2011b). There is some suggestion, however, that the focus on scientific uncertainty may be misdirected. In an empirical study of Swedish climate change policy, for example, Knaggård (2014) demonstrates that the defining aspect of conveying science to policy decision-making is whether the scientific information is framed as politically accessible, with decision-makers focusing on what is politically possible. Decision-making under uncertainty in this case is thus more dependent on *realpolitik*; that is, whether an issue can be connected to existing political values and interests (Heazle 2012). Fisher et al. (2015) argue that the reality of the political arena in relation to climate science means that science is far more beholden to politics than politics is to the science. Political echo chambers also allow decision-makers to selectively respond to climate science in order to enhance their own political needs. Uncertainty can, therefore, either legitimate political decisions to act or postpone or not act (Heazle 2012; Knaggård 2014). Such findings align with political science research into the science-policy nexus, such as multiple streams theory (discussed in Part 4 of this literature review), which examines opportunities for policy influence and change (Kingdon 2010). This suggests that in circumstances of uncertainty scientific information must be framed in a political context—a context in which scientists

and knowledge communicators are less willing to act, as it contradicts the discourse of neutral science (Knaggård 2014). Despite such concern, Gluckman (2014) argues that science advisers are required to mediate the knowledge and knowledge framework they wish to convey and to be capable of recognising the limits of science. This may require science advisers to suggest other types of knowledge and expertise to support a fuller perspective of the issue, thus contributing a plurality of perspectives and epistemologies, enhancing the legitimacy of the decision (Kovacic 2017).

Scientific research, monitoring and feedback is a commonly identified regulatory response to complexity, along with the recognition that scientific uncertainty should not hinder or stymie governance responses. However, as Kovacic (2017, 81) writes,

> Ambiguity and uncertainty are not necessarily a problem of insufficient evidence and are not always a temporary deficit that can be overcome with more research, but rather reflect the limits of a single representation of the system and invite a plurality of perspectives to the scientific knowledge base. Complexity allows to build pluralism in scientific representations and to account for different levels of uncertainty.

Munda (2004) writes that decision-making for complex ecological systems also requires ontological characterization, as well as epistemological plurality. The 'values' or what is important for social decision-making must be defined, as well as what is relevant, as different social actors will have differing axiologies (see also Cosens et al. 2021). Local and traditional knowledge and community engagement is, therefore, considered essential to building consensus and operating in conditions of post-normal science (Ravetz 2004). Scholars suggest that governing in complexity should not simply update environmental law's anthropocentric narrative of reason and liberalism by supplementing it with 'scientific

description' (Anker 2017). Rather, it should recognize that legal regimes reflect values, narratives and worldviews, which requires multidimensional approaches, multiple perspectives and epistemic pluralism (Munda 2004) to integrate multiple types and sources of knowledge and values in governance for complexity (Brunner et al. 2005).

Law and regulation that seek to govern social-ecological systems face significant challenges in responding to the uncertainty of complex systems and the novel conditions of the Anthropocene (McDonald 2011; Kotzé 2017; Karkkainen 2004; Ruhl 2012). Unlike other areas of law (such as intellectual property, where values are framed by culturally and socially derived parameters), environmental governance is informed epistemically by ecological systems (Philippopoulos-Mihalopoulos 2011a). In response to the challenges of complexity, multiple management, governance and legal approaches have been developed and put forward to address questions of complexity and governance. Early recognition of the problem by Holling and Meffe (1996, 334) resulted in the authors arguing for environmental management that 'retain[s] critical types and ranges of natural variation in ecosystems … facilitat[ing] existing processes and variables rather than changing or controlling them'. Koons (2011) called for governance approaches that are polyarchic, adaptive and place- and context-specific as a response to the complexity evident in earth systems. Ruhl (2012), Karkkainen (2004) and Garmestani et al. (2008) all advocate for legal systems and governance processes to be scaled to the social-ecological systems the seek to govern with cross-scale communication and governance (see also Garmestani and Benson 2013; Ostrom 2010). Complex adaptive legal systems should be able to provide some level of guidance but also have the flexibility to adapt (Underdal 2010), allowing for incremental change when information is insufficient for longer term decision-making, ensuring ongoing monitoring

and evaluation, creating reflexive response systems and not locking in optimistic assumptions (McDonald 2011; Folke et al. 2005). Terms such as adaptive management (Allen et al. 2011; Garmestani, Allen, and Cabezas 2008), adaptive governance (Folke et al. 2005; Chaffin and Gunderson 2016; Chaffin, Gosnell, and Cosens 2014), adaptive co-management (Olsson, Folke, and Berkes 2004; Plummer 2013), co-productive governance (Chambers et al. 2022; Wyborn et al. 2019; Wyborn 2015), polycentric governance (Galaz et al. 2012; McGinnis 1999; Ostrom 2010; 2012) and anticipatory governance (Hurlbert 2018b; Heo and Seo 2021; Ramos 2014) have all been put forward to address the challenges of complex systems. As the applicability of adaptive approaches to the regulation of ecological restoration is a research objective, it will be addressed in some further detail below. Procedural based responses to complexity include Pellizzoni's (2004, 557) conceptualization of 'responsive' governance, which takes a receptive approach to external inputs to making decisions. This means that the regime will have a level of 'openness, a willingness to understand and confront the other's commitments and concerns with ours, to look for a possible terrain of sharing. It entails readiness to rethink our own problem definition, goals, strategies, and identity' (Pellizzoni 2004, 557). Another procedural response is that of reflexive law. Drawing on the concept of autopoesis, scholars such as Luhmann (2004), Teubner (1983) and others put forward a legal approach that aims to install, redefine and correct democratic self-regulatory instruments to facilitate a better fit between institutional and social structures (see also Paterson and Teubner 1998). Reflexive law is much more concerned with communication and the procedural requirements of legal systems than the substantive requirements, like principles.

Scholars who are more concerned with developing legal principles for governing in complexity suggest the harmonization of legal systems with the inviolable 'laws of nature'. Law can be both good or bad in managing complex adaptive systems. Ebbesson and Hey (2013), for example, argue that attention is needed to examine normative values in law and resilience research, while Wijkman and Röckstrom (2013) advocate for the recognition in law of planetary limits that constrain a safe operating space for humanity. These 'laws of nature' are considered fundamental legal norms in the sense that if they are not heeded, the very conditions for the possibility of human law will cease to exist (Cullinan 2011). Other approaches and theories include: earth jurisprudence, which situates the human sphere within a broader community of life (Berry 2000; Burdon 2015); wild law, which sets out laws consistent with earth jurisprudence (Cullinan 2011); ecological law and governance, which envisions a mutually enhancing human-earth relationship within a systems approach (Garver 2019; 2013; 2020); and earth system law, which institutes the juridical elements of earth system governance and is orientated to addressing the conditions of the Anthropocene (Kotzé 2019; Kotzé and Kim 2019), amongst others. These concepts all aim to bring law in line with ecology, setting out principles that seek to re-envision the human-nature relationship.

Adaptive governance, also known as adaptive co-management (Chaffin, Gosnell, and Cosens 2014; Huitema et al. 2009), adopts an iterative learning approach to the management of social-ecological systems and incorporates the social and collaborative aspects of socio-ecological systems (Hurlbert 2018b). Adaptive governance seeks to understand and respond to environmental and social feedback in the context of change and uncertainty in order to enhance the resistance and resilience of desired socio-ecological systems (Cvitanovic et al.

2015; Berkes, Colding, and Folke 2002). This might mean incremental change when the information available from monitoring is insufficient for longer term decision-making (Buckley and Niemi 2011). Adaptive governance focuses upon the formal and informal institutional arrangements required for the management of shared natural resources (or other assets) (Cvitanovic et al. 2015; Nelson, Howden, and Smith 2008). Adaptive governance aims to build flexible institutions and social networks in multi-level governance systems to improve adaptive capacity to understand and respond to uncertainty, surprise and external drivers (Berkes and Folke 1998; Hatfield-Dodds, Nelson, and Cook 2007). Adaptive governance also requires the incorporation of different kinds of knowledge, including local and scientific knowledge (Munaretto, Siciliano, and Turvani 2014), to build trust and relational learning (Huitema et al. 2009).

Adaptive governance has been criticized for being minimally effective as a tool of transformation, particularly for large-scale problems (Ostrom 2007; see also Eshuis and Gerrits 2019; Sharma-Wallace, Velarde, and Wreford 2018)—although it has been noted that it is difficult to assess the results of adaptive governance (Chaffin and Gunderson 2016; Sharma-Wallace, Velarde, and Wreford 2018). Adaptive governance has also been criticized for not paying sufficient attention to questions of equity, power and agency (Cote and Nightingale 2012; Wyborn et al. 2019; Clark and Harley 2020; Olsson et al. 2015; Chaffin and Gunderson 2016). Governance that adopts complexity science does not necessarily or explicitly solve questions of governance equity, with emergent governance at risk of only addressing problems for certain members of society or adopting inequitable goals (Cosens et al. 2021). As a result, there have been recent attempts to incorporate issues of power and agency in systems of governance and complexity through concepts such as co-productive

governance (Chambers et al. 2022; Wyborn 2015; Wyborn et al. 2019; Jasanoff 2010; Hill et al. 2020) or by drawing on other theories (such as political ecology and anthropology (Fabinyi, Evans, and Foale 2014)) to address issues of power, politics, equity and diversity (Karpouzoglou, Dewulf, and Clark 2016; Williams 2020).

Part 2: Ecological restoration and its regulation

Ecological restoration

Ecological restoration is recognized as a complement and tool of environmental conservation and management (Benayas et al. 2009; Kearney et al. 2020; Samuel 2020; Iftekhar et al. 2017). Among its multiple definitions, the most commonly used is the definition from the international Society for Ecological Restoration (SER) standards, which defines ecological restoration as the process of 'assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed' which 'aims to move a degraded ecosystem to a trajectory of recovery that allows adaptation to local and global changes, as well as persistence and evolution of its component species' (Gann et al. 2019, s6). Ecological restoration is, and occurs within, complex adaptive systems. There are many measures of such complexity. As a result, metrics of ecological restoration have moved away from singular attributes in the assessment of recovery (such as carbon accumulation or taxonomic richness) to more complex metrics that seek to assess the interactions between system components (Moreno-Mateos et al. 2020; Jones 2017; Perino et al. 2019), including assessing ecosystem function and process (Weinstein, Litvin, and Krebs 2014), even if assessing ecosystem processes is done through the more readily measured proxy of ecosystem

structure (Prach et al. 2019). Weinstein et al. (2014) have also pushed ecological restoration research and practice to acknowledge that ecosystems are located in larger systems and that a landscape approach to restoration efforts, which considers ecological restoration at a variety of scales and across habitat linkages and energy fluxes, is required. This approach requires the application of landscape ecology as well as the integration of social elements, such as governance, across landscapes. Drawing upon resilience and complexity theory, Perino et al. (2019) identify trophic complexity, stochastic disturbances and dispersal as critical processes for successful re-wilding projects. Ecosystem function, self-organization and ecological resilience mark successful, systems-based ecological restoration (Weinstein, Litvin, and Krebs 2014).

While the focus of the SER definition of recovery focuses on the ecological elements of a system, social elements of recovery are also considered in the standards (Gann et al. 2019). The social elements of ecological restoration are also well addressed in the literature (Elias, Joshi, and Meinzen-Dick 2021; Dave Egan, Hjerpe, and Abrams 2011; Fischer et al. 2021; Martin 2017). Social science research, for example, considers the normative goals of ecological restoration (Fischer et al. 2021), including the integration of social and ecological motivations (Jellinek et al. 2019), and the process of including social indicators in defining restoration and in monitoring systems (Martin 2017; Martin and Lyons 2018; Prach et al. 2019). In relation to setting normative goals, Fischer et al. (2021, 20) argue that, ultimately, ecological restoration is a normative undertaking in that it 'seek[s] to improve the world, be it in terms of biodiversity or ecosystem functioning, or to improve human well-being'. They also set out six socio-ecological themes from socio-ecological systems thinking, which they consider relevant to answering the normative questions of ecological restoration: (i)

resilience and adaptability of social-ecological systems; (ii) people as stewards who navigate complexity; (iii) relational values to bridge gaps between actors; (iv) coevolution of social and ecological systems; (v) long-range connections of social-ecological systems; and (vi) 'deep' leverage points (Fischer et al. 2021). In relation to monitoring ecological restoration, Martin and Lyons (2018) note that monitoring frameworks rarely track who benefits from restoration or by how much. Using flood protection and recreation as example benefits to illustrate in their analysis, Martin and Lyons (2018) propose three social indicator categories and measures: (i) access for institutions, processes, or means that enable people to derive benefits from ecological restoration; (ii) beneficiaries of the restored ecosystems; (iii) and quality of benefit, noting that higher quality indicators provide greater benefits. Prach et al. (2019) set out a primer on how to choose goals and indicators to evaluate ecological restoration success, and caution that, in the assessment of success, the subjectivity of expert opinion and experience must be considered.

Normative goal setting and monitoring is linked to the governance of ecological restoration projects and the decision-making processes that projects adopt or should adopt (Clement and Standish 2018; Gellie et al. 2018; Guerrero et al. 2017; Hodge and Adams 2016a; Nilsson et al. 2016). There has been significant research into the legal and regulatory arrangements for the delivery of ecological restoration (Palmer and Ruhl 2015; Bell-James, Boardman, and Foster 2020; Richardson 2016; Fidelman et al. 2019; Richardson and Akhtar-Khavari 2019; Richardson and Lefroy 2016; Telesetsky 2013; Telesetsky et al. 2016.

Effective evaluation of ecological restoration and recovery is essential to governance and a key area of research. Nilsson et al. (2016) found that evaluation was lacking in ecological restoration practice; where it did occur, it was predominantly oral, with formal evaluation

and documentation lacking. This may be because failures are less likely to be reported and because there is a lack of resources for long-term monitoring. Nilsson et al. (2016) hold that evaluation is necessary for adaptive management and advocate for a change to funding arrangements. The authors developed a framework to examine the evaluation of phases of ecological restoration and evaluation between the particular phases.

Other researchers have focused on the cultural elements of ecological restoration (Kimmerer 2011; Bartel and Graham 2019; Light 2003; Van Wieren 2008; Long, Tecle, and Burnette 2003). Furness (2021), for example, has established that the human and nature relationship can be improved with participation in restoration, while Benayas et al. (2009) found that ecological recovery is more likely with active engagement than with self-recovery. Terms such as 'landscape restoration', 'eco-cultural restoration', 'focal restoration' and 'reciprocal restoration' have been developed to define practices concerned not only with scientific value but also aesthetic, historical and traditional landscape values, reflecting an understanding that the presence of humans can be an integral part of thriving, resilient landscapes (Barbour and Schlesinger 2012; Egan, Hjerpe, and Abrams 2011; Kimmerer 2011; Moreira, Queiroz, and Aronson 2006; Naveh 2005). Reciprocal restoration, as Kimmerer (2011, 258) explains, is 'the mutually reinforcing restoration of land and culture such that the repair of ecosystem services contributes to cultural revitalization and renewal of culture promotes restoration of ecological integrity'. Such culturally informed definitions of ecological restoration emphasize that the inclusion of local and traditional environmental knowledge and narratives (Robertson et al. 2000) contribute to diachronous understandings of local socio-ecological systems (Kimmerer 2011; Barbour and Schlesinger 2012; Hill et al. 2012) and articulate the interdependency between human and environmental health (Graham 2014;

Suchet-Pearson et al. 2013). As many Indigenous and non-Indigenous authors have stated, many emerging ecological concepts in Western science have their antecedents in Indigenous land management (Kimmerer 2011; Moreira, Queiroz, and Aronson 2006). This necessarily rejects historical baselines or historical reference ecosystems, which have been called the colonial conceptualization of pristine and 'untouched wilderness' (Garver 2016).

Ecological restoration imbued with social and cultural values has also resulted in scholarly recognition that landscapes have multiple values and functions, which are not limited to natural resources and ecosystem services, but are also related to aesthetics, sense of place, cultural heritage, recreation and economics (Fischer et al. 2021; Higgs 2003; Martin 2017). Significant consideration has been given to the ecosystem services of ecological restoration and the monetary (and non-monetary) valuation of those services (Alexander et al. 2016; Benayas et al. 2009; Boerema et al. 2016; Ciccarese, Mattsson, and Pettenella 2012; Hughes et al. 2016; Jenkins et al. 2010; Tolvanen and Aronson 2016).

The literature has also begun to consider ecological restoration's temporal alignments and its influence on law and governance. Richardson (2019; 2017) writes that ecological restoration requires the acknowledgement and remediation of past damage. This contrasts with the usual orientations of sustainable development, which largely seek to forestall or foreclose future environmental degradation, and thus requires a temporal re-orientation of liberal environmental law's 'present future' (Richardson 2015).

A brief overview of the law and regulation of ecological restoration in Australia

At the international level, the United Nations (UN) General Assembly has declared 2021-2030 the decade of ecosystem restoration. International treaties, such as the *Convention on Biological Diversity* (CBD),[3] the *UN Convention to Combat Desertification*[4] and the *Ramsar Convention*,[5] amongst others, provide for specific and active restoration obligations across a number of ecosystem types and subject areas. For example, forest restoration globally is influenced by a number of international law regimes, including the CBD, the *United Nations Framework Convention on Climate Change* (UNFCCC)[6] and the Sustainable Development Goals (SDGs), along with programs such as Reducing emissions from deforestation and forest degradation in developing countries (REDD+) and the Bonn Challenge, which set out more specific aims with respect to forest restoration. Scholars note that these regimes are fragmented and more is required to co-ordinate and integrate international (environmental) law around ecological restoration (Aronson and Alexander 2013; Telesetsky et al. 2016).

At the federal level in Australia, a patchwork of regulation dedicated to ecological restoration grapples with post-extractive landscapes and liabilities (Richardson 2015; 2017). The recent *Samuel Review* (2020) into the operation of Australia's leading environmental act, the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act), found a lack of comprehensive national regulatory frameworks in Australia for facilitating restoration.

[3] *Convention on Biological Diversity*, opened for signature 5 June 1992, 1760 UNTS 79, (entered into force 29 December 1993) art 8(f).
[4] *United Nations Convention to Combat Desertification*, opened for signature 14 October 1994, 1954 UNTS 3, (entered into force 26 December 1996).
[5] *Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat,* opened for signature 2 February 1971, 996 UNTS 245 (entered into force 21 December 1975).
[6] *United Nations Framework Convention on Climate Change*, opened for signature 4 June 1992, 1771 UNTS 107 (entered into force 21 March 1994).

Australia's current species-to-species and threat-to-threat approach within the EPBC Act was only leading to managed decline (Samuel 2020, 128). In response to these challenges, the *Samuel Review* (2020) recommended stronger integrated planning, with adaptive regional planning and adaptive national planning with clear national standards. From a regional perspective, the report recommended the implementation of regional recovery plans developed in line with the National Environmental Standards, with quantitative performance targets and monitoring and reporting against these targets. If recovery is not being achieved, the report recommended that plans be adaptive and adjust accordingly (Samuel 2020, 132–34).

Across the Australian states, standards and regulation of ecological restoration is largely limited to discrete areas, such as mines and former industrial sites, and also discrete industries (Richardson 2017). Regulation has been criticized for being poorly defined and enforced (Akhtar-Khavari and Richardson 2019a). The lack of integrated regulation and planning for restoration has also been found to hamper restoration efforts, with government funding models often ad hoc and limited in their scope, application and time scales (Samuel 2020, 137).

Part 3: The neoliberal state and the regulation of social-ecological systems

To assess and draw out findings on the ongoing failure to achieve recovery, a significant element of this thesis addresses the underlying ideologies of regulation. As critiques of environmental law illustrate, there are significant contradictions and paradoxes in the way in which state institutions regulate the environment (M'Gonigle and Takeda 2013).

Environmental law and regulation exhibits a 'deep contradiction' in that it has been developed by the state, but the state is also the primary driver of development; it can therefore be considered a form of 'self-regulation' (M'Gonigle and Takeda 2013). Central to such critiques is the observation that environmental regulators and state institutions seek to uphold and legitimize land degradation by market creation and regulation of natural resources while simultaneously protecting local communities and the broader public from the negative social and ecological consequences and externalities of these activities (Ioris 2015; M'Gonigle and Takeda 2013; Osborne et al. 2021). It has been suggested that the more the modern state engages with environmental concerns, 'the more it promotes or endorses the exploitation of socionature and widens the gap between society and its ecological condition' (Ioris 2014, ix). This paradoxical approach is said to arise from the application of the ideology of neoliberalism to law and regulation.

The term 'neoliberalism' has been deployed in various ways with diverse definitions. First established as a term in Latin America (Grewal and Purdy 2014), it became more entrenched in the West, with the governments of Margaret Thatcher in the United Kingdom and Ronald Reagan in the United States in the 1980s (Burdon and Stewart 2019). Humphrys (2015, 70–71; as cited in Burdon and Stewart 2019) illustrates the diversity of the use of the term, writing that neoliberalism can be used to describe '(1) a doctrine, set of ideas and/or ideology; (2) a set of economic policies, an entire economic regime and/or a distinct phase of capitalism; (3) a political project, form of politic al rule and/or type of state; (4) a category of denunciation or criticism; and (5) a complex mix of some or all of these elements'.

As an ideology, neoliberalism is said to support market imperatives by a mode of reasoning that monetizes all things and moulds human conduct to the market (Brown 2017). In the

political environment, it is said to support the unequal economic power of elites (Grewal and Purdy 2014, 2; see also Harvey 2005). Neoliberalism is less about the re-invention of classical liberalism and more about the 'intensification of a familiar and longstanding "anti-regulatory" politics' (Grewal and Purdy 2014, 1). In this context, markets are for capital accumulation, rather than for any other social purposes (Grewal and Purdy 2014); critically important to capital accumulation have been the related, intertwined and ongoing processes of enclosure, urbanization, colonization and globalization (Federici 2021; Graham 2011; Harvey 2004; Polanyi 2001). Federici (2021) details the enclosure movement in eighteenth- and nineteenth-century Britain, where legislative instruments were used to enclose common lands, forcing much of the rural population into urban areas. This process allowed for the privatization of the commons and an urbanized work force for bourgeoning industrialization. Colonization, urbanization and globalization have displaced, and continue to displace, people around the world, often reducing their living conditions and also reducing the value accorded to public things (Layard 2016). Davies (2021, 26) sums up the concept simply by stating, 'Neoliberalism has removed the fetters from private accumulation, for instance through the privatization of public resources, by reduced government control, and by an emphasis on self-interest and aggressive individualism'. Turner (2017, 798), however, cautions that neoliberalism has not resulted in complete privatization, as '[u]nfettered private property and commodification, despite the rhetoric, do not serve society or capital interests. This reflects not only Polanyi's double movement but the demands of capital for government-provided services that are critical for accumulation'.

Neoliberalism also involves an 'ideological expansionism', with concepts of efficiency, autonomy and individualism informing law and policy outside the traditional political areas

of economics to structure life along market priorities (Grewal and Purdy 2014, 3, 5; Blalock 2014). Grewal and Purdy (2014, 6) set out four premises that characterize neoliberalism's ideological reach, the first being 'efficiency-based "market fundamentalism"' which assumes that property and private rights are the most appropriate way of increasing welfare. The second premise assumes that strong property rights best protect the freedom of individuals, while the third rejects democratic politics and institutions as appropriate managers of economics. The final premise assumes that certain policy options are completely inappropriate in influential circles, therefore limiting their political possibility (Grewal and Purdy (2014, 6); for example, nationalising banks.

This ideological expansion of neoliberalism is said to result in an inherent conflict as social needs and market growth rarely align (Streeck 2011). Piketty's (2014) empirical analysis of capitalist states demonstrates conclusively that increasing inequality exists with increasing capital, especially since the 1970s. To counter this inherent conflict, proponents of neoliberalism have expanded its ideological reach through the 'construction of consent' (Harvey 2005, 39–63), resulting in a hegemonic restructuring of the state-economy relationship (Peck, Theodore, and Brenner 2010). A hegemonic state of affairs exists if a 'particularity' becomes or claims universality, regardless of the cultural context (Lange 2015, 161 building on the ideas of Laclau and Mouffe 2001). As articulated by Gramsci (1973), hegemony is both an analytical tool that seeks to understand political economies and a strategizing tool for transforming political economies (Laclau and Mouffe 2001; Williams 2020). Applying hegemony as a critical lens, scholars have argued that neoliberal market-orientated approaches have come to dominate social domains through cultural hegemonies. Boon and Prahalad (2017, 115–16), for example, argue that conservation and ecology has

become dominated, with little critique, by neoliberal ideology's two key assumptions with respect to ecosystems: (i) that ecosystem services can and should be monetarily quantified as the best possible allocation of the value of ecosystem services; and (ii) that establishing complementary areas to offset biodiversity loss is the most efficient way of balancing nature conservation and economic development.

Far from being a bystander, the neoliberal state plays 'an active role in supporting the market and correcting market failures' (Blalock 2014). A market cannot exist without the mediation of law, regulation and policy to define economic rights (such as property and contractual rights) and the processes of exchange (Grewal and Purdy 2014, 7–8; Blalock 2014). Unregulated markets cannot guarantee their own reproduction, with the regulation of labour forces, natural resources and money essential for ongoing accumulation and expansion (Polanyi 2001; McGee and Steffek 2016). The commonly portrayed conflict between the state and the overreach of its regulatory mechanisms and the market is said to be a false one, with the conflict instead being a demand for particular governmental systems and particular relationships between the state and the economy (Peck and Tickell 2007, 33).

Significant scholarly critique of neoliberalism (Freeland 2012; Aldred 2020; Slobodian 2020; Brown 2017) relates to its pervasive influence on and with conservation (Boon and Prahalad 2017; Perkins 2011; Arsel and Büscher 2012), environmental regulation and management (Bernstein 2002; Castree 2010; Kolinjivadi et al. 2019; Lockie 2009), and law and legal theory (Blalock 2014; Brabazon 2017; Burdon and Stewart 2019; Grewal and Purdy 2014), amongst many other social domains.

Part 4: Transformation and theories of change

This next part of the literature review considers transformation and processes of transformation for pluralistic futures.

Transformation

The concept of transformation of social systems has had a long history, with early adopters of the term including the political economist Polanyi (2001), who described transformation as a fundamental restructuring of the state, economy and distribution after a shift in society's mindset and values. More recently, scholars have turned their attention to transformation for sustainable futures (Bennett et al. 2019; Stirling 2015; Temper et al. 2018). Gobby et al. (2022, 2) define transformation as 'intentional change that 1) confronts the root causes of social injustice and environmental unsustainability, including unequal power relations, and 2) alters the overall composition and behaviour of the system in ways that drive desirable outcomes across temporal and spatial scales, including increased social wellbeing, equality and ecological sustainability'. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (2019, 14) simply defines transformation as 'fundamental, system wide reorganization'. Stirling (2015) makes a careful and heuristic distinction between transition and transformation, arguing that transition narratives suggest a manageable, orderly shift within current systems that are peaceful, whereas transformation involves radical, potentially unruly, systemic changes in governance and cultural values and norms (see also Temper et al. 2018). Drawing on the historical literature of transformation, Patterson et al. (2017, 3) note that transformations are necessarily complex and political, with change occurring across multiple systems and resulting from the

co-evolutionary interactions between systems. Common to all these definitions is an acknowledgement that transformations for sustainability are deeply political (Scoones, Leach, and Newell 2015; Patterson et al. 2017) and require explicit consideration of power and structure (Newell 2015).

Significant scholarly attention has also been paid to the intertwined and overlapping fields of governance *for* transformation (Folke et al. 2005; Olsson, Folke, and Hahn 2004), the governance *of* transformation (Loorbach 2010; Wittmayer et al. 2017; Stirling 2015) and the transformation of governance (Leventon, Duşe, and Horcea-Milcu 2021). Lam et al. (2020), for example, consider methods of amplifying sustainability initiatives to foster transformation and set out a typology of eight amplification processes to support sustainability transformations. Fazey et al. (2020) and Vargas Roncancio (2019) consider sustainability transformations in the context of higher education and knowledge production.

While the state is often overlooked in social-ecological system studies (Duit 2011), recent literature on sustainability transformation highlights the key role of the state in enabling or preventing transformation (Mazzucato 2011; Routledge, Cumbers, and Derickson 2018; Scoones, Leach, and Newell 2015). In capitalist states, the state is responsible for mediating the interests of capital and environmental protection (Ioris 2015), as well as mediating between capital and labour (Newell 2015), which can fundamentally affect sustainability transformations. Radical transformative movements can therefore work 'in, against and beyond' state structures (Angel 2017; Routledge, Cumbers, and Derickson 2018); such movements are not only oppositional, but can also transform states, or hegemonic power, into new configurations (Laclau and Mouffe 2001; Mouffe 2013)

Theories of change

There are many diverse theories of change, from individual to systems approaches. In line with complexity theory and political theory, this section of the literature review sets out two theories of change which are institutional (Vatn 2005) and can occur within complex systems.

Meadows (1999) explicitly considers change and theories of change in complex adaptive systems, and proposes a hierarchy of 12 categories of leverage points, from least to most effective in transforming systems. Leverage points are places for intervention in a system that have larger effects than other points, with cascading outcomes throughout a system: 'where a small change in one thing can produce big changes in everything' (Meadows 1999, 1). The effectiveness of the leverage point generally depends upon how deeply embedded it is. Deeper leverage points can create transformational change as they address root causes of unsustainability, whereas shallow leverage points will create only small changes. Meadow's leverage point framework can be arranged into three 'transformative layers' within a complex system (United Nations Environment Programme 2012, 423). The 'surface layer' is a collection of leverage points that monitor system feedback and adjust environmental pressures. The 'mid layer' is made up of rules and incentives to influence drivers and create structural change. The 'deep layer' is about paradigm change and transformation. The deeper the leverage point, 'the more the system will resist changing it' (Meadows 1999, 19; see also Avelino and Rotmans 2009; Patterson et al. 2017). Essential to this theory of transformation is monitoring for intended and non-intended change, as small perturbations in complex

systems can create sudden feedbacks (Meadows 1999). Meadow's framework has been applied to studies of the transformation of legal systems (Garver 2019), biodiversity (Leventon, Duşe, and Horcea-Milcu 2021) and sustainability transformations (Beddoe et al. 2009) amongst many others.

Panarchy theory helps to set out processes for navigating transformation of complex systems with three key steps: (i) preparing a system for change; (ii) navigating a transition in the governance regime when a window of opportunity emerges; and (iii) consolidating the new regime (DeCaro et al. 2017; Gunderson and Holling 2002; Herrfahrdt-Pähle et al. 2020).

Political theory has also developed a theory of change that considers the processes of effecting public policy change, with research on what has been called the 'policy window' (Kingdon 2010). Also known as multiple streams theory, a policy window is a window of opportunity for policy shifts, when three streams—problem, policy and politics—converge at a point in time. The problem stream includes problems that citizens and policy-makers want addressed, such as climate change or budget deficits (Zahariadis 2007). The policy stream consists of policy communities that prepare policies for policy windows. The politics stream is the political environment in which policy-makers feel comfortable in making policy changes (Farley et al. 2007). A policy window emerges when an event (such as a natural disaster, civil disobedience or an election) occurs in the politics stream. This facilitates the merging of the three streams, allowing the policy stream to implement an already developed policy in response to the problem and politics. A key actor in multiple streams theory is a policy entrepreneur, who is able to tie the three streams together conceptually to effect change. Policy entrepreneurs can also use information to leverage changes to context, meaning and policy at different points in the process (Zahariadis 2007).

Researcher across different disciplines have sought to identify ways of predicting and responding to policy windows more effectively (Farley et al. 2007; Rose et al. 2017; Meijerink 2005). Rose et al. (2017) set out four ways for conservation and environmental scholars to respond to policy windows: (i) foreseeing (and creating) emergent windows; (ii) responding promptly to policy windows; (iii) framing research in line with policy windows; and (iv) persevering outside policy windows.

Plural futures

Despite significant efforts on behalf of legal positivism and modernist hegemonies, we do not live in a single reality (Davies 2022, 105). Research into social-ecological systems recognizes that universal law and governance frameworks do not exist (Ostrom, Janssen, and Anderies 2007) and that a diversity of regulatory responses is required for social and ecological wellbeing (Parker and Haines 2018). As a result, there has been significant scholarly interest in designing transformation and theories of change that are pluralistic, open ended and informed by democratic processes (Munda 2004; White 2017). For example, Laclau and Mouffe (2001) have developed conceptualizations of radical pluralist democracies that draw on neo-marxists such as Gramsci and, to some extent, Foucault to discursively consider social domains. In these conceptualizations, Laclau and Mouffe (2001, 105) do not assume social domains are unified and homogenous and do not assume a universalizing experience: 'Society never manages fully to be society because everything in it is penetrated by its limits, which prevent it from constituting itself as an objective reality' (Laclau and Mouffe 2001, 127). In their political philosophy, Laclau and Mouffe (2001, 96, 5, xvii) argue that there is no key principle that organizes society, but rather that 'the social' is made up of inevitable

antagonisms and diverse social orders and difference which provide for the construction of pluralist democratic politics.

Leventon et al. (2021, 4) write that plurality in complex system transformation can be facilitated through supporting local, meaningful governance, incorporating diverse knowledges and shifting away from systems built on profit generation. Social-ecological system management and governance approaches that address plural values include deliberative approaches (Lliso, Pascual, et al. 2020; Lliso, Mariel, et al. 2020; Zafra-Calvo et al. 2020), co-creation, design and transdisciplinary research (Hirsch Hadorn et al. 2006; Mauser et al. 2013; Vienni-Baptista et al. 2022), and co-production of knowledge (Chambers et al. 2022; Wyborn et al. 2019; Wyborn 2015). Chambers et al. (2022), for example, present critical 'tensions' they consider productive in transformation, noting that their approach is not to resolve tensions and seek consensus, but rather to 'stay with the trouble' (Haraway 2016) or discomfort to allow for pluralistic futures. Their study found four collaborative pathways from these tensions to transformations: (i) 'elevating marginalised agendas' to broaden the struggle for justice; (ii) 'questioning dominant agendas' to allow for more inclusive transformations and make powerful and dominant actors accountable; (iii) 'navigating conflicting agendas' to bring actors together and deliberate; and (iv) 'exploring diverse agendas' to foster shared understandings and respect for plural worldviews and values (Chambers et al. 2022, 9).

Commentators have noted, however, that democratic processes will need to be reinvigorated for pluralistic democratic futures as dominant neoliberal approaches have caused significant damage to democratic practices and cultures, with participation in the marketplace replacing democratic deliberation (Brown 2017; Routledge, Cumbers, and Derickson 2018)

Part 5: Some further notes on the adaptive theory model of research

Much of this thesis is concerned with ontological or paradigmatic questions and the ways in which law expresses particular ontologies or paradigms. This section briefly sets out some notes on the adaptive theory model of research to complement the careful explanation of method in Chapters 2 to 4. Ontology refers to the nature of being and the underlying culture of social reality (see Heidegger (1996) amongst others for a detailed explanation). Theory is essential to uncovering ontological questions as it makes visible the meanings 'embedded in complex reality' (Guru and Sarukkai 2012, 23). Ontology can make visible or invisible certain knowledge(s), and theory is essential to revealing these subjectivities (Escobar 2016).

Adaptive theory explicitly considers ontological and theoretical questions by abandoning the distinction between theory and method and seeking to engage with the investigation of social realities or ontologies in undertaking research (Layder 2021; 1998). The adaptive theory model of research proposed by Layder (2021, 47) involves an open and empirically informed process with three particular elements: (i) a generalising lens that sets out a global or universal perspective operates in conjunction with (ii) a local lens that particularizes an empirically informed image of social reality; and (iii) these generalising (global) and particularising (local) lenses are then merged and analysed with the production of integrated explanations.

To incorporate questions of social ontology, Layder (2021) suggests that 'multiple strategies' rather than 'mixed methods' need to be adopted. These include a more inclusive array of ontological and validity issues, as well as concurrent qualitative and quantitative data and

method. The adaptive theory and method model also emphasizes the importance of explanations rather than descriptions and integrates theory from ontological models and empirical evidence from data. Key to this is flexible design and adaptive sampling, which means that the problem under investigation is continuously explored and reformulated as the research continues (Layder 2021). Layder (2021) posits that this approach avoids the one-dimensional social ontologies of positivist, post-positivist and post-modern approaches, with multi-dimensional and variegated social reality models emerging instead.

Other methods adopted by this thesis are set out in Chapters 2, 3 and 4 to make explicit the methods of research and inquiry.

Chapter 1

Chapter 1 of this thesis represents the following manuscript: Boulot, E. and Akhtar-Khavari, A. (2020) 'Law, Restoration and Ontologies for a More Ecologically Complex World!' (2020) 39(3) *University of Queensland Law Journal*, pp. 449–73. The manuscript is presented here in full and identical to the version that was submitted, excluding the formatting and referencing style which has been amended for consistency with the rest of the thesis.

This chapter aims to address the first two research objectives of the thesis:

1. To examine how traditional environmental law and regulation responds to the high levels of uncertainty present in complex, adaptive socio-ecological systems.
2. To investigate the regulation of ecological restoration.

This chapter presents a comprehensive literature review to address the first two objectives and begins by exploring the ways in which environmental regulation to date has grappled with socio-ecological uncertainty. The manuscript grounds the analysis in ecological restoration and finds that regulation has largely failed to adequately capture the complex relations between the transformations of social and natural systems. This poses significant issues for the regulation for ecological restoration, a complex social-ecological process where scholarship to date has argued that the regulation and governance of ecological restoration should be guided by adaptive and reflexive processes. Using two regulatory case studies, mine rehabilitation and closure (MR&C) and forest restoration, this paper considers adaptation in these contexts, before putting forward a new ontological framing for ecological restoration law that aims to add complexity to systems.

Since this paper was published in 2020, a number of reforms have been made to the MR&C regulatory framework. This chapter is included unedited; for a more up-to-date description of the regulatory frameworks for MR&C in Queensland, readers are referred to Chapters 2 and 3.

Law, Restoration and Ontologies for a More Ecologically Complex World!

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Abstract

Restoration efforts can target very different outcomes. Simply put, restoration is a process, and diverse values and ontological dispositions can shape the why, what and how questions about what people do. Restorative inputs focused on adaptively adding complexity into an ecosystem commits to values that go beyond rehabilitating and just removing threats and harms that are disturbing an ecosystem. Restoring within a landscape to enhance its ecological complexity is a useful goal for adaptive governance, and one which will also enable discussions about how humans and legal and governance institutions can change and respond to managing the environment. Using two scenarios we briefly explore how governance approaches to restoration need ontological dispositions focused on ecological complexity. In particular, we argue in this article that a focus on inputs into ecological complexity creates not only opportunities for overall net gain, but also, and more critically, that it requires legal and governance changes that establish parameters for how the vision will be realised. We explore and briefly discuss four of these institutional challenges to chart further research trajectories for how restorative inputs into ecological complexity can be achieved.

I Introduction

In a recent review of the signature conservation legislation in Australia, the *Environment Protection and Biodiversity Conservation Act 1999* (Cth), *The Independent Review of the Environment Protection and Biodiversity Conservation Act 1999* ('Interim Report') identified the thin governance framework around restoration as a major reason for the Act not having

achieved its goals (see Samuel 2020). The report then went on to identify restoration as a necessary complement to protection and conservation strategies in order to 'enable future development to be sustainable' (Samuel 2020, 13). It defined restoration as improving 'the condition of the environment to a state that is required to be sustainable in the long-term, or a state that is desirable' (Samuel 2020, 86, box 21). This definition was set against an alternative, which the report identified as 'a blanket ambition for a return to a particular historic environmental condition' (Samuel 2020). From this starting point, the Interim Report suggested, rather simply, that offset schemes need to be reimagined to achieve restoration.

This is a good start, given that the Interim Report was clear about the ineffectiveness of offset schemes to actually 'offset the impact of development', but it appears to reinforce a narrow approach that is usually taken to adapting and responding to damage, disturbance and degradation. While the report rejects 'historical' baselines as a measure of complexity, there is little to suggest that the changes envisioned will aim at anything beyond remediating and rehabilitating the environment so that ecosystems can sustain themselves without human input. While this review of a crucial piece of Australian legislation continues to put the attention on restoration, it also continues to situate restoration as part of a reactive strategy to manage the natural environment, once it has been damaged to a point that it matters to human beings.[7] The Interim Report went as far as suggesting that offsets in Australia need to contribute to restoring new areas, but it stopped short of pushing for deeper ecological gains that required developers to contribute to genuine gain in native ecosystems and higher

[7] The United Nations has declared 2021–2030 the Decade for Restoration, bringing further attention to this subject. For more information, see <https://www.decadeonrestoration.org>.

levels of complexity in those systems. Given that restoration can support a range of values and ethical dispositions, there is always the risk that restoration will not get articulated as managing disturbances to recover complexity, but rather to achieve a 'desirable' future landscape.

This article seeks to describe an alternative approach to restoration governance and regulation, so as to draw attention to the value of transforming the normative and ontological foundations of environmental law. A burgeoning practice in governing restoration activities is adaptively and reflexively doing the work over a period of time. Reponses to damage and degradation, and also offsets that seek to genuinely restore a site, require the use of long-term adaptive approaches in order to ensure successful restoration outcomes, particularly at the landscape scale (Aronson et al. 2009; Standards Reference Group SERA 2017; Cabin 2007; Hodge and Adams 2016; Nagarkar and Raulund-Rasmussen 2016; Simenstad, Reed, and Ford 2006). In this article we discuss how governance for ecological restoration needs a strong value base in addition to adaptive and reflexive processes, and we propose the term 'restorative inputs' to describe the aim of building complexity through restoration as a normative goal. This approach is ultimately a surer way of ensuring long-term ecological gain. Transactional arrangements that typically exist for net-gain instruments like offsets do not always focus on restorative inputs that build complexity, as this is expensive and can take a long time to deliver.

In Parts II and III we explore how discussions of complexity can usefully inform environmental law approaches to restoration, by first pointing to its ontological frailties and problems, and practically by focusing attention on the benefits that adaptive governance brings to managing restoration processes. In Part IV we draw on two short governance

scenarios within Australia to illustrate these points. In Parts V and VI we explore and discuss how 'restorative inputs' can complicate, but usefully add to, adaptive governance frameworks, and conclude by outlining governance frameworks required for an approach that seeks to add complexity to systems. While the focus on restorative inputs that add complexity to a system has already been discussed elsewhere (Akhtar-Khavari 2020), this article brings together discussions of the institutional and governance significance and potential of these ideas, and critiques and frames important environmental law responses going into the future.

II The Ontological Paradox of Environmental Law

It is through the instruments of law and governance that decisions are made informing land management and landscape function, as well as species conservation, ecosystem management and processes, influencing intergenerational landscapes and responses to environmental damage. Our current environmental law and governance systems are, however, failing to prevent and remediate the ecological degradation that distinguishes the Anthropocene era (Kotzé 2017; Robinson 2014; Grear and Grant 2015). Traditional notions of environmental governance struggle to adequately capture the complex relations between global transformations of social and natural systems (Biermann et al. 2012), and tend to approach environmental management in a predominantly efficiency-driven, transactional, command-and-control way, prioritising front-end processes to predict and assess environmental harm in a balancing act with economic growth, national interests and social stability (Philippopoulos-Mihalopoulos 2011; Ruhl 2012). Along with the legal illusion of

control and stability that remains prominent in international and national norms (Philippopoulos-Mihalopoulos 2011), environmental governance continues a single-trait, maximum-sustained yield paradigm that is top-down, bureaucratic and efficiency-driven, aiming to produce goods and services in a predictable manner (Chaffin, Gosnell, and Cosens 2014; Holling and Meffe 1996; Garmestani and Benson 2013). This assumes that the environment is bounded and problems can be solved through linear cause-and-effect frameworks that either control the processes leading to the problem or ameliorating the problem after it occurs (Holling and Meffe 1996). This governance approach, by which we mean a system where collective goals are identified and decisions and actions are undertaken to achieve these collective goals, linking the social and the ecological (Chaffin, Gosnell, and Cosens 2014), advances principles such as sustainable development and 'polluter-pay'. Such principles are well-suited to managing bounded environmental problems, such as point-source pollution, and maintaining the status quo by protecting private property, national statehood, risk and liability management, and fostering predictability and stability, but ill-suited to governing the omnipresent, uncertain and pervasive 'thing' that is 'the environment' (Pellizzoni 2004).

Environmental law is deeply informed by both the tradition of legal positivism and positivist interpretations of environmental realities continuing a particular ontological framing (Graham, Davies, and Godden 2017). Environmental law continues to reinforce a constructed dichotomy between the sphere of the *anthropos* and that of the natural world. The former is viewed as operating above or outside the functions of the latter. Nature, in environmental law, is abstracted and sheared from social context (both human and more-than), becoming passive or non-agentic and, therefore, *res nullius*: a resource empty of meaning and purpose

and available for annexation. It is this dichotomy that forms Western environmental law's ontological canon (Grear 2017; Kotzé and French 2018; Vermeylen 2017).

While conceptualisations of 'the environment' have largely arisen through the application of an epistemology that necessitates and privileges technical scientific knowledge and a belief in control, the rise of an ecological narrative, in which humans are recognised as a part of the environment which itself has myriad forms of agency, culture and history, with complex interactions and relationships between subjects, has begun to challenge the operation of environmental law. This 'new ecology', emerging from systems-science perspectives, accepts that natural systems operate far from equilibrium and assumes the possibility of uncertainty, instability and variability in natural systems (Godden and Peel 2010; Steffen et al. 2005). McMichael (2001, 21–22) argues that this systems approach of ecological science

> embraces the complex interplay between animate and inanimate components; it studies dynamic, non-equilibrial and non-linear processes ... To an ecologist the world is neither deterministic nor randomly unpredictable; rather, it is a world of contingent probabilities within mutually adapted, self-ordering systems.

Socio-ecological systems — that is, the bio-geophysical ecological unit and associated social actors and institutions — have been characterised as complex adaptive systems ('CAS') (Steffen et al. 2005). This means that the characteristics of such systems cannot be captured using a single perspective (Munda 2004), but are instead a set of components 'interconnected in such a way that [they] produce their own pattern of behaviour over time' (Meadows 2008, 2). Mitchell (2009, 13) defines a CAS as 'a system in which large networks of components with no central control and simple rules of operation give rise to complex collective behaviour, sophisticated information processing, and adaptation via learning or evolution'. The collective behaviour resulting from component interactions is therefore more than the sum of the behaviour expected of individual parts (Newman 2011), exhibiting

non-linear relationships, unpredictability, autopoiesis, adaptation and emergent behaviour (Funtowicz and Ravetz 1994). Such processes support system identity and self-organisation (Kim and Bosselmann 2013), adapting to changes in their external environment through conditional action and anticipation (Kauffman 1995; Levin 1999) and exhibiting coherence under change (stable disequilibrium) (Bak 1996; John Henry Holland 1995). In contrast to the epistemic belief in objectivity within the scientific method, a systems approach does not assume that the act of observation is a neutral pre-analytical step. Rather, decisions as to what and how to observe a system become crucial analytical requirements determining the representation of the system (Kovacic 2017).

The complexity and uncertainty of these systems raises challenges for environmental, institutional and governance arrangements (Folke et al. 2005; Young and Steffen 2009), not least because uncertainty is no longer confined geographically or jurisdictionally, temporally, or by relationships of duty between those creating the harm and those who are harmed. Uncertainties are recognised as not only analytical, but also normative, with traditional and reductionist approaches of prediction and control being of limited effectiveness. Uncertainty, inherent to the scientific method, lack of coherence between scientific understandings (Sarewitz 2004) and complex adaptive systems, challenges the reliability of rational decision-making processes (Tallacchini 2005, 648) where certainty as a possibility is assumed (Knaggård 2014). Rational assumptions that the environment can be controlled and that certainty can be achieved, fundamentally ring false thus questioning the very ability of environmental law 'to become or even to be law' (Philippopoulos-Mihalopoulos 2011, 22). The 'unsettling internalisation of scientific uncertainty' in environmental law results in 'constant re-evaluation of already established problem-solving

methodologies' (Philippopoulos-Mihalopoulos 2011, 21), requiring ongoing generation and application of new knowledge (Tarlock 2004).

Environmental law and governance have increasingly been attempting to fill the gaps where uncertainties have emerged. Processes of prediction and control only result in incoherence and fragmentation, inadequately capturing the important, non-linear and complex interconnections between ecological and social systems (Ruhl 2012; Kim 2013). Holling and Meffe (1996) have observed that traditional governance approaches reduce the natural variation of ecological systems by applying rules for fixed yields, resulting in the perverse effect of increased uncertainty as the resilience of ecosystems diminish — ecosystems being more likely to break down in response to disturbances that could have been previously absorbed (see also Levin et al. 2013).

Many new governance solutions have been put forward to respond to these questions of dynamism, uncertainty and complexity in strongly coupled socio-ecological systems, as well as in response to the fundamental uncertainty created by the novel conditions of the Anthropocene (Karkkainen 2004; Koons 2011; Ruhl 2012). In the next part, we discuss one such response, namely, adaptive governance in the context of a complex socioecological process: ecological restoration.

III Adaptation and Ecological Restoration

Legal systems have a key role in responding and adapting to questions of dynamism, uncertainty and complexity inherent to socio-ecological systems (McDonald 2011; Kotzé 2017). The environmental governance challenge of our time is the development of

governance systems that can respond to, adapt to, manage, and recognise the inherent uncertainty, interdependencies and dynamic conditions of these systems in which we live, in order to restore and maintain life-sustaining earth processes (Kotzé 2020; Philippopoulos-Mihalopoulos 2017, 131). Ecological restoration is an example of a complex, systems process (Weinstein, Litvin, and Krebs 2014). Ecological restoration refers to the process of assisting the recovery of a damaged ecosystem to restore ecological structure, complexity and integrity so that the system is self-supporting, resilient and displays a level of historical continuity and fidelity (Higgs 2003; Standards Reference Group SERA 2017; Suding et al. 2015; Telesetsky 2013). The practice of ecological restoration does not assume restoration to a replica environment, as landscapes are dynamic, but rather envisions an ecological system that is self-sustaining, historically informed, with ranges of variability and multiple potential ecological trajectories (Balaguer et al. 2014; Higgs et al. 2014; Palmer and Ruhl 2015; Suding et al. 2015). As ecosystems can take decades or centuries to restore, evaluation is therefore a necessary tool in avoiding costly mistakes (Nilsson et al. 2016).

The National Standards for the Practice of Ecological Restoration developed for Australia note that restoration is an adaptive, reflexive and systemic practice guided by site characteristics and the relationship of the site with socio-ecological systems, including climate, landscape function and community (Standards Reference Group SERA 2017). Ecological restoration therefore requires long-term conservation management, review processes and changes in direction in order to correct for unexpected ecosystem responses — conditions requiring flexible and adaptive governance regimes to account for high levels of uncertainty and imperfect understandings of ecosystem interrelationships and feedback (Hodge and Adams 2016; Weinstein, Litvin, and Krebs 2014). As such, adaptive approaches,

such as adaptive management and adaptive governance, have been widely recommended to govern ecological restoration (Aronson et al. 2009; Standards Reference Group SERA 2017), particularly landscape scale projects (Cabin 2007; Hodge and Adams 2016; Nagarkar and Raulund-Rasmussen 2016; Simenstad, Reed, and Ford 2006).

Adaptive approaches shift environmental law's focus to the back-end of governance processes, requiring continuous monitoring, evaluation and adjustment in achieving an optimal socio-ecological system. Adaptive governance, for example, is defined as the social conditions and context that mediate human interactions with ecosystems, resulting in a 'range of interactions between actors, networks, organizations, and institutions emerging in pursuit of a desired state for social-ecological systems' (Chaffin, Gosnell, and Cosens 2014, 61). It attempts a paradigmatic shift from a singular reductionist approach governing singular parts of an ecosystem, to one that seeks to understand and respond to the dynamism and uncertainty of the whole socio-ecological system (Chaffin, Gosnell, and Cosens 2014). This approach recognises that top-down, centralised state-based environmental governance approaches generally do not match ecological complexity or provide effective solutions (Young 2002; Cumming, Cumming, and Redman 2006). Adaptive governance responses to these challenges therefore often emerge through community-led, bottom-up initiatives (Brosius, Tsing, and Zerner 2005; Weber 2003). Ongoing explorations of adaptive governance strategies in law and decision-making have shown it to be a relatively successful environmental governance response (Ebbesson and Hey 2013; Garmestani and Allen 2014; Garmestani, Allen, and Benson 2013; Sharma-Wallace, Velarde, and Wreford 2018), and it has been applied to studies of watershed management (Cosens, Gunderson, and Chaffin 2018; Cosens et al. 2014; Huitema et al. 2009; Huntjens et al. 2012; Kallis, Kiparsky, and

Norgaard 2009; Scholz and Stiftel 2005), management of desert areas (Nelson, Adger, and Brown 2007), regional drought management (Nelson, Howden, and Smith 2008), the Great Barrier Reef (Hughes et al. 2007; Olsson, Folke, and Hughes 2008; Schultz et al. 2015), and urban sustainability (Vandergert et al. 2016; Yasmin, Farrelly, and Rogers 2019), as well as some ecological restoration sites (Butler, Monroe, and McCaffrey 2015; Gunderson and Light 2007).

IV Illustrating the Challenge with Law and Ecological Restoration

Despite ecological restoration being a current global priority,[8] the law and governance arrangements for ecological restoration are still emerging as states grapple with post-extractive landscapes and liabilities (Aronson and Alexander 2013; Palmer and Ruhl 2015; Telesetsky 2013; Telesetsky et al. 2016). To investigate the governance of ecological restoration, we discuss two governance case studies from Australia to illustrate the ideas discussed above in Parts II and III.

Land development, particularly through resource extraction, is considered a highly appropriate use of land in Australia. The resource industry in particular has made significant efforts to brand activities in language that associates extraction with 'frontier development', 'prosperity' and 'nation-building', with mining equated with bringing wealth and civilisation to the outback (Trigger 1997; 1998). In this discourse, resource extraction is thus a moral imperative (Trigger 1997; 1998). With the rise of environmentalism in the 1970s and 1980s,

8 For example, the United Nations General Assembly declared 2021–2030 the decade of ecosystem restoration. See <https://www.decadeonrestoration.org>.

a growing recognition emerged that development- and growth-focused industries had serious environmental and social consequences resulting in attempts to bring 'sustainable development' to mining and other industries (Chase 1994; International Council on Mining & Metals 2008; 2015; Maini 1992; Wiersum 1995; World Bank Group and International Finance Corporation 2002). Resource-rich states began to consider the impact of industry on landscapes and the cost that closure and rehabilitation has upon future land-use activities (Australian Government 2006a; 2006b).

Mine sites across Australia have become major environmental risks after closure, with an estimated 60,000 abandoned mines (Unger et al. 2012). Environmental risk remains an ongoing concern' with '[m]ine closure, complete rehabilitation and relinquishment of the former mine site [being] almost unknown' in Australia (Campbell et al. 2017, 2). As a result, more stringent government policies and the adoption of sustainable development practices have materialised across many industries in an attempt to reduce the environmental risk and costs of post-extractive landscapes.

Regulation to date, however, has been largely concerned with the rehabilitation of discrete geographical areas — for example, the rehabilitation of a mine site, remediation for pollution or other environmental disasters, or the conservation of a particular species (Richardson 2017). Such governance approaches are often limited in scope and ambition. We provide two examples of restoration governance within Australia: mine restoration in Queensland, and forest restoration in Tasmania.

Mine Restoration in Queensland

In Queensland, the Department of Natural Resources and Mines and Energy ('DNRME') is responsible for mine compliance, land access and abandoned mines. The Department of Environment and Science ('DES') is responsible for the environmental management of operating mines and overseeing mine site rehabilitation, which is required under the *Environmental Protection Act 1994* (Qld) ('EP Act Qld'). Rehabilitation is required to reduce disturbance caused by authorised mining activities and to minimise future potential environmental harm. Mining proponents must apply for an environmental authority in order to conduct mine activities, with the application detailing the proposed rehabilitation of the site post operation.[9] This is detailed in a rehabilitation management plan ('RMP'). The DES assesses the RMP and also assesses rehabilitation for part of,[10] or the part or whole of, a mining project being surrendered.[11]

RMPs are informed by departmental guidelines that establish a rehabilitation hierarchy: the top requires the avoidance of disturbance that will require rehabilitation or the reinstatement of a 'natural' analogous ecosystem, through to lower levels that seek to provide rehabilitated land to allow for land use that accords with previous or lower value or, at the most undesirable, leaving the site in an unusable condition or with the potential to generate future pollution or adversely affect environmental values (Department of Environment and Science 2014). Mine operators are required to achieve the highest practicable rehabilitation level and identify post-mining land uses that are acceptable to the

9 EP Act (Qld) s 125(1).
10 Ibid s 318Z.
11 Ibid s 264.

community, local government and other relevant stakeholders. General rehabilitation goals, that can ensure the safety of humans and wildlife through non-polluting and stable landforms sustaining an agreed post-mining land use, must also be met. Site-specific goals may be applied in relation to endangered species, water, registered heritage, or regional or local planning.

Despite this regulatory framework, the Queensland Audit Office's (2013, 15) review of Queensland's environmental regulation found the environmental remediation of mines was 'an unrealised aspiration'. The review found there were serious mine legacy concerns, with the state being left with an increasing number of abandoned mines, with mining bonds often inadequate to meet the cost of rehabilitation (Queensland Audit Office 2013). As a result, the government introduced the *Mineral and Energy Resources (Financial Provisioning) Act 2018* (Qld), amending the EP Act (Qld) to incorporate Progressive Rehabilitation and Closure ('PRC') Plans into the environmental authority process for both new and existing mines. The PRC Plans include an approved schedule containing completion dates for achieving progressive rehabilitation of mine sites. This step-by-step approach aims to achieve a level of adaptive management throughout the restoration process and limit the risk of state liability for abandoned mines (State of Queensland 2018).

Forest Restoration Tasmania

Tasmania's forest management system is largely regulated under the *Forest Practices Act 1985* (Tas). The Act seeks to 'achieve sustainable management of Crown and private forests with due care for the environment and taking into account social, economic and

environmental outcomes'.[12] The forest practices system establishes a tenure-blind approach, regulated by the Forest Practices Code ('FPC'), forest practices plans ('FPPs'), forest practices officers ('FPOs') with independent oversight and reporting by the regulator, and the Forest Practices Authority ('FPA'). The FPA notes that the 'Tasmanian forest practices system is based on an adaptive management approach where results from research and monitoring lead to continuing improvement of the system' (Wilkinson 2008), with the FPC aiming to provide 'reasonable protection' for the environment.

Under both the FPC and the *Forest Practices Act 1985*, restoration is not a required part of forest activities, but it does occur through the 'best practice' of forest companies or under their FPPs, particularly as all plantation companies operating in Tasmania are certified to either the Australian Forestry Standard and/or the Forest Stewardship Council. Forest restoration is recognised under both of these certification standards, and Tasmanian forestry companies have an economic incentive to meet those standards (Schofield 2017).

In addition, while not mandatory under the FPC, the FPC does influence forest restoration by setting out requirements in relation to the retention of existing native forest streamside reserves, conservation of riparian values, establishment of native vegetation, and constraints on harvesting (Forest Practices Authority 2015, 78). If a forest company intends to undertake restoration, an FPP is required, resulting in a protocol for planning, implementation and compliance reporting. FPPs are generally implemented by FPOs and forest contractors familiar with the requirements of the FPC and technically capable. The

[12] *Forest Practices Act 1985* (Tas) sch 7.

desired reforestation standard is generally expressed as stems/ha of eucalypt seedlings 12–24 months after treatment and inevitable mortality in FPPs (Schofield 2017).

Analysis

Law is never simply a collection of inviolable rules and processes. Laws and governance regimes reflect narratives, stories and worldviews; they are fundamentally the expression of a lifeworld (Mills 2016). Therefore, it is not enough to update environmental law's anthropocentric narrative of reason and liberalism by supplementing it with 'scientific description' (Anker 2017, 198). Overcoming the alienation of earth systems present in environmental law requires knowledge of alternative ways of being and existing in the world in a way that supports an ecological logic. This knowledge should not be reduced to empirical description (Anker 2017) or a process of adaptation and learning. Such approaches are at risk of being simply technical and rules-based responses to a much broader ontological concern.

This is demonstrated in the governance case studies above. In both jurisdictions, we can observe a continuing conceptualisation of ecosystems as 'resources', defined by their use value. Rehabilitation governance is largely concerned with future use of the land (particularly in the mining example) or maintaining access to markets through certification (forestry practices in Tasmania). Standards are limited to metrics of disaggregated ecosystem aspects, that is, soil or water quality and stable landforms in the case of mining restoration in Queensland, or single species coverage in the case of forest restoration in Tasmania. Adaptive approaches are included in both of the governance frameworks, but

appear to have been largely implemented to facilitate processes that limit state liability in the case of the progressive rehabilitation in Queensland, and to allow for an agile organisation in the case of the independent regulator in forest management in Tasmania. While these are certainly important goals, adaptive management in the case studies did not seek to improve ecological complexity. The complexity inherent in the relationships between the social and ecological components of these systems is assumed to develop on its own over a period of time.

Adaptive approaches have been criticised for their failure to attend sufficiently to questions of agency, power, culture and history (Cote and Nightingale 2012; Davidson 2010; Fabinyi, Evans, and Foale 2014; Welsh 2014). And it is in this criticism that we can observe a failure to truly break the anthropocentrism of environmental law. Adaptive management and governance, despite their attempts to recognise the sociality of natural systems, still continue a particular worldview in which ecological systems are often framed as a legal 'object' or resource. Agency within these systems is largely limited to the 'human', and questions of diversity, equity and power relations, when raised, are primarily concerned with an environmental justice that centres on the human (Chaffin, Gosnell, and Cosens 2014).

This means that in doing the restoration work, landscapes remain at risk of continuing to be a commodity, or recovery efforts are simply a required intervention for maintaining the use value of private property. Critically, it means that restoration efforts do not add as much to the structural and trophic complexity that is needed in the system, so that at some point human being decisions are not central to sustaining the system. According to the five-star recovery system used in the recent ecological restoration standards of the International Society of Ecological Restoration, ecosystems can accumulate complexity to the point that it

is naturally regenerating itself. Using this system, for instance, restoration efforts can help achieve sustainability, but not necessarily complexity for the system under consideration.[13] This distinction is illustrative simply of the opportunities for adaptive governance, and the importance of having substantive goals, as well as process goals for restoration efforts. The mining and forestry examples highlight the lack of this ambition in achieving complexity.

V Building Complexity: Challenging Law's Anthropocentrism with Restorative Inputs

To help achieve greater ecological complexity through a legal system conducive to a 'future that has a future' (Escobar 2018, 9), we want to explore in this part how the idea of 'restorative inputs' can shape values differently and contribute substantively to law and governance, shifting its ontological commitments. Conceptually, restorative inputs are similar to other innovative ideas, like net-gain, no-net-loss, half-Earth (Wilson 2016), and a host of others that set abstract limits and conditions on activities so that performance can be measured against them. The idea of restorative inputs is to go beyond technical solutions and reorient the ontological frames of ecological restoration law and governance and move beyond technical solutions and a largely extractive and property-based relationship with the more-than-human world. Restorative inputs aims to create social institutions that reorient ontologies towards more cooperative relationships between human beings and the natural

[13] See McDonald et al. (2016) for a discussion of the five-star system that seeks to explain the levels of complexity that a system can achieve, with the highest level being one where there are very high similarities between it and the reference ecosystem. This five-star system was adopted by the 2019 2nd edition of the Society for Ecological Restoration as part of its *International Principles and Standards for the Practice of Ecological Restoration*. See also McDonald and Dixon (2018).

world. The aim, therefore, is not to create more stringent rules to manage the transactional and competitive access arrangements between human beings, but rather to enable cooperative acts and initiatives that can build new ontologically significant social and cultural institutions.

Ecological restoration is not concerned simply with remediating and rehabilitating an ecosystem; it can also shape how humans conceive of and relate to the natural environment by actively working on inputs into achieving greater complexity.[14] By focusing on complexity and native systems, it is a practice that can facilitate the development of a partnership ethic between 'the human' and 'the more-than-human', envisioning 'a better relationship between humans and the rest of the world' (Egan, Hjerpe, and Abrams 2011; Merchant 2003). Undertaken with broad stakeholder and community involvement and engagement, ecological restoration can ground and attach people to places in which they live with deep metaphysical or emotional connections, motivating people to care for ecosystems beyond the services they provide or their aesthetics (Akhtar-Khavari and Richardson 2019; Bartel and Graham 2019; Van Wieren 2008), even instilling a sense of stewardship or responsibility with respect to land and property (Barritt 2019, 72; Bartel and Graham 2019). In this, restorative inputs into the complexity of a system is similar to terms such as landscape restoration, eco-cultural restoration, focal restoration and reciprocal restoration. Such terms define practices concerned not only with scientific value but also aesthetic, historical and traditional landscape values, reflecting an understanding that the presence of humans can be an integral part of thriving, resilient landscapes (Barbour and Schlesinger 2012; Egan,

[14] See Jordan (2003). This book is increasingly recognised as one of the first monograph-length discussions of the significance and benefit of restoration for changing the human–nature relationship.

Hjerpe, and Abrams 2011; Moreira, Queiroz, and Aronson 2006; Naveh 2005). Reciprocal restoration, for example, as Kimmerer (2011, 258) explains, is 'the mutually reinforcing restoration of land and culture such that the repair of ecosystem services contributes to cultural revitalization and renewal of culture promotes restoration of ecological integrity'. Restorative inputs build on these concepts, framed by a commitment to socio-ecological complexity.

Restorative Inputs and Complexity

As we have identified, ecological restoration is both a complex, systems process, and also an ambition to achieve more than just rehabilitation and remediation (Weinstein, Litvin, and Krebs 2014; Palmer and Ruhl 2015). Ecosystems and socio-ecological systems can be considered complex adaptive systems. Markets, regulations and institutions, however, have a tendency to break down landscapes, ecosystems and bioregions into smaller units for the purposes of trade, markets and regulation of rights. Ecosystems are reduced to their components, such as taxonomic richness, water and soil quality, undermining the appreciation of the overall complexity of these systems (Norgaard 2010). Regulation, therefore, does not generally define restoration as a self-sustaining system focused on function and process, but rather promotes an 'undue emphasis' on physical habitat (Palmer and Ruhl 2015, 514). This can also result in the prioritisation of certain restoration goals, such as carbon sequestration, over others, resulting in unintended circumstances for objectives such as biodiversity (Buckley and Niemi 2011, 177). This can result in the recovery of only part of an ecosystems ecological function, process and socio-ecological

benefits (Moreno-Mateos et al. 2020). It also risks what Higgs (2003) calls *technological restoration* — a scientific-technical practice dominated by elite experts and technicians, concerned with efficiency and uniformity, resulting in restoration as commodity. The practices of rehabilitation and reclamation often used in mine closures and other extractive practices, concerned with ensuring the reparation of ecosystem components, provides an example. The ecosystem services narrative provides another example of where restoration governance and policy internationally is at risk of continuing the ongoing commodification of ecological systems and the reduction of ecosystems into component functions (Higgs et al. 2014; Telesetsky 2013). This has troubling connotations for the governance of ecological restoration:

> [E]nvironmental governance can no more succeed around the metaphor of ecosystem services apart from the richness of ecological thinking than mortgage markets can succeed on the myth that housing prices will always rise … Somehow, we need to make a significant transition toward richer ways of understanding and governing (Norgaard 2010, 1225).

A governance framework built around restorative inputs is therefore an attempt to contribute to a deeper articulation of a restorative law and governance framework for ecological restoration, anticipating, fostering and conscientiously defending restoration governance from the ontological and epistemological frameworks of traditional forms of environmental law and governance that continue to disaggregate and commodify the 'natural' world (Boulot 2021).

A restorative input approach aims to recognise the significance of the whole and the complexity of all the entanglements that come together within a landscape. Scientific knowledge and decision-making is therefore but one part of the process for making good

decisions, as historical, cultural and emotional connections continue to be integral to understanding the natural world.[15] Governance of such landscape-based approaches would necessarily require an orientation to considering ecosystem function, dispersal, stochastic disturbance, self-organisation, trophic complexity and ecological resilience, which mark successful, systems-based ecological restoration (Moreno-Mateos et al. 2020; Perino et al. 2019; Weinstein, Litvin, and Krebs 2014). Such an approach focuses on the interactions between ecological system components rather than simply just the components themselves (Moreno-Mateos et al. 2020). In addition, the complexity of such landscapes cannot be maintained and realised without meaningfully acknowledging and entrenching *relational* dimensions of the entangled and connected parts of the world into governance decisions and frameworks. How this will translate to governance is the question we explore next, setting out some initial theorisation as to governance tools and mechanisms that would support and foster complexity, rather than reducing and disaggregating it.

VI Restorative Governance

In this part, we explore key parameters for a governance framework committed to restorative inputs and building complexity through adaptation-oriented approaches. We identify four particular elements. First, the governance of complex systems requires a governance approach that is systems-based, reflexive and responsive to the inherent uncertainty of these systems. Second, governance must ensure that restoration is integrated across the landscape, both spatio-temporally and jurisdictionally. Third, restorative input

15 This theme comes up in this article a fair bit: Campbell et al. (2017).

governance requires a long-term approach, recognising that successful restoration with self-supporting complexity may take centuries or millennia, thus challenging the temporality of traditional environmental law (see Richardson 2017). Finally, as many scholars have identified, there is no one governance solution to questions of complexity. Governance must be heuristic, recognising and responding to the very place-specific nature of complex systems management.

Systems Thinking and Law

As noted above, socio-ecological systems are inherently dynamic, exhibiting non-linearities, no central control and behavioural surprise. This means that predicting and managing restoration trajectories 'has been particularly vexing' (Weinstein, Litvin, and Krebs 2014, 72; Anand and Desrochers 2004; Mitsch et al. 1998; Ruiz-Jaen and Mitchell Aide 2005). Legal systems have a key role in responding and adapting to these questions of dynamism, uncertainty and complexity in strongly coupled socio-ecological systems (Kotzé 2017), with ecologists arguing that governance should be adaptive, long-term and implemented through networks of stakeholders (Hodge and Adams 2016).

Systems theory, however, has not only been applied just to the physical sciences (although there is significant work done in this space) (Gell-Mann 1994; Holland 2006; 1995; Kauffman 1995; Levin 1999; Mitchell 2009). It has also been applied across the social sciences, including environmental law (Kim 2013; Kim and Bosselmann 2013; Ruhl 2008; 1997), policy (Emison 1996) and management (Ostrom 1999; Rammel, Stagl, and Wilfing 2007; Dietz, Ostrom, and Stern 2003). It has been adopted as a framework for addressing social-

ecological issues by environmental governance scholars from around the world, including the Stockholm Resilience Centre (Folke et al. 2005; 2007; Duit et al. 2010), the Resilience Alliance (Low et al. 2003, 83) and the Complex Adaptive Systems Initiative (Janssen 1998). The literature shares a common premise that the command-and-control approach to natural resource management has inherent limitations (Holling and Meffe 1996) and there is no one-size-fits-all solution (Ostrom, Janssen, and Anderies 2007); rather, responses need to be context-specific, with institutional diversity (Ostrom 2005), redundancy (Low et al. 2003) and self-organisation (Dietz, Ostrom, and Stern 2003; Folke et al. 2005; Per Olsson et al. 2006) in a polycentric (Ostrom 2010), nested (Dietz, Ostrom, and Stern 2003) or network organisational setting (Janssen et al. 2006). Law itself is a complex adaptive system, with Ruhl (2012, 1) arguing we should be 'adaptively managing the complex adaptive legal system to adaptively manage other complex adaptive natural and social systems'.

In our thinking with restorative inputs, we agree with Conant and Ashby (1970, 89) that 'every good regulator of a system must be a model of that system'. According to Duit et al.'s (2010; see also Ruhl 1997; 2008) diversity hypothesis, efficacious adaptiveness is achieved when the variety of environmental law's internal order or complexity matches its external order, that is, the variety of the environmental constraints. There are, of course, many approaches to the inherent uncertainty in socio-ecological systems, but adaptive and precautionary approaches would appear to be necessary policy structures (Ruhl 2012; Gunderson and Holling 2002). Truly restorative governance requires a systems approach to support the establishment and development of complexity across landscapes, and it is here that the learning processes of adaptive governance can be well applied.

Landscape Integration

A landscape approach recognises that ecosystems are interconnected, and their ecological processes are inherently complex (Newman et al. 2019). Ecological restoration should therefore consider the variety of scales with cross-habitat linkages and energy fluxes that exist across the landscape (Weinstein, Litvin, and Krebs 2014). Decisions regarding restoration would need to consider the natural environment in the context of its restorative conditions. Principle 7 of the second Primer of the International Society for Ecological Restoration contains the idea that restoration efforts can accumulate across a landscape.[16] On this Principle the Primer encourages planning at the landscape level to achieve complexity as it accumulates across the area over time and connects restored areas with one another. More importantly, 'landscape' incorporates both ecological and social elements, addressing spatial and temporal scales (Wu and Hobbs 2007). It is the scale at which 'identity to place' emerges (Wu 2012, 441). Not only does this require the application of landscape ecology, recognising that ecosystem sustainability varies across spatio-temporal scales, it also requires a recognition that governance will be need to be integrated across multi-level jurisdictional boundaries. Governance that can support partnerships, remove regulatory barriers and coordinate across bioregional scales will be required.

16 See Principle 8 of the Society for Ecological Restoration's International Principles and Standards (Gann et al. 2019).

Long-Term Approach

One of the significant benefits of having a vision for restorative inputs built around complexity and relationality is that it positions governance approaches on a long-term trajectory. Initiatives that are designed to help restore native ecosystems can take decades, centuries or millennia of inputs (Moreno-Mateos et al. 2020). Whatever the motivation or strategy, the challenge for governance in relation to long-term initiatives for building complexity will be monitoring, evaluation and adaptation to changing circumstances. Further, integrated schemes that continue to support and sustain one another without affecting the cumulative value of what is being achieved is critical.

Instruments found in most current legislation focus more on short-term agendas and transactional opportunities and less on learning how to pass on knowledge and undertake effective succession-planning for the next generation. Funding that recognises the multi-generational nature of ecological restoration becomes a key requirement and can sustain effective restoration over the time that is required.

Multitude of Governance Responses

As has been eluded to throughout this article, ecological restoration is place- and context-specific. Governance that seeks to incorporate social and ecological system complexity must recognise that universal frameworks do not exist (Ostrom, Janssen, and Anderies 2007); rather, a suite of policy responses will inevitably be required (Garmestani and Benson 2013). As Campbell, Alexandra and Curtis (2017, 410) note:

> Over the past four decades, we have learnt that land restoration demands long-term approaches, durable policy settings and continuity of resourcing, of both social and biophysical interventions capable of using a full suite of policy instruments — educative, informative, inventive, market and regulatory.

Restorative input governance therefore requires a heuristic framework for the design and operationalisation of regulation acknowledging that governance in this space will be difficult to measure, maintain and replicate under ongoing ecological change (Sharma-Wallace, Velarde, and Wreford 2018). While bottom-up place-specific approaches are certainly effective for adaptive governance implementation, support from higher levels, with cross-scale connections and nesting will be necessary for operationalisation (Garmestani and Benson 2013).

Restorative inputs could take many forms and shapes, and its significance would be in terms of facilitating deeper engagement with the impacts and influences that we have on one another and, more importantly, nature. Ontological change is challenging, and disruptive technologies and ideas are needed to help us shift from competitive to cooperative relationships that can enable a different evolutionary socio-ecological platform.

VII Conclusion

Without attending to the ontological foundations of law, adaptive governance for restoration will continue to replicate its presuppositions regarding the human–nature binary[17] as demonstrated by the governance frameworks for mine and forest restoration in Queensland

[17] See a similar critique with respect to ecological economics: Kolinjivadi (2019).

and Tasmania. But when practiced with a governance approach that recognises the human as a part of, and dependent upon, the natural world (Higgs 2003), restoration has the potential to enable what Van Wieren calls a 'de-centering' of the liberal subject of environmental law, thus eroding human–nature dichotomies (Van Wieren 2008; see also Barritt 2019; Kimmerer 2011; Higgs 2003). Decentring the human subject, however, requires a commitment to building on the complexity that is inherent in the ecological systems of which human beings are a part. We have sought to argue that governance approaches to restoration that support human goals and ambitions are not as concerned with building and adding complexity into a system.

By initiating a discussion on a values-led restoration governance, we have outlined a framework for using restorative inputs to bring an additional dimension to adaptive governance processes. Restorative inputs into 'ecological restoration' make explicit the need to focus primarily upon the development of complexity, that is, processes including ecosystem function and process. In this we can observe a shift away from solely human agency, to a whole-of-landscape consideration of agency. Restorative inputs are therefore an example of an earth-sustaining ontology, where there is active engagement in the consideration of a mutually beneficial relationship between humans and nature.

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Chapter 2

Chapter 2 sets out to empirically investigate the third research objective; that is, determine whether regulation that recognizes complexity and is adaptive is an appropriate response to the high levels of uncertainty in socio-ecological systems. In so doing, this chapter examines the regulation of ecological restoration (Research objective 2) across three case studies (mine rehabilitation and closure (MR&C), forest restoration and landscape restoration) to ground the analysis. Four key characteristics of adaptive governance are identified, and the case studies are examined to determine the extent to which they adopt these adaptive governance characteristics. Some further comments are then made regarding the appropriateness of adaptive approaches within regulatory frameworks for ecological restoration.

The case studies and the resulting analysis are informed by 37 participant interviews. Thirty-four interviews were transcribed verbatim and imported into NVivo 12 software to support the organization, analysis and coding of the data. The coding hierarchy for this chapter can be found in Appendix 3.

The key contribution of this chapter is that it considers what has been a research gap - research on the governance of complex social-ecological systems has largely focused on bottom-up initiatives, rather than the role of the state and state regulation. This might be because strategic-level regulatory responses often fail to support the emergence of local adaptive governance responses or because of a perceived need for context specific, community led approaches. This means adaptive governance has emerged in an ad-hoc manner as state institutions are unlikely to regulate without a statutory mandate (Wyborn

and Dovers 2014) and it also means that adaptive governance is not occurring at rates that combat environmental decline (Cosens et al. 2021). In situating regulation as the key research interest with respect to adaptive governance, this chapter makes findings that are relevant both to the nascent literature on the role of regulation for adaptive governance and to those regulatory systems interested in adopting adaptive approaches.

Regulation for social-ecological recovery: are adaptive approaches sufficient?

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Abstract

Ecological restoration has gained significant international traction as a response to biodiversity loss and climate change across the globe. Defined as 'the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed' (Gann et al. 2019, S7), ecological restoration is an activity, or process; recovery is its objective. However, despite support for the practice, the regulatory arrangements for ecological restoration governance are still emerging at both national and international scales. Adaptive planning, management and governance for ecological restoration have been key recommendations for emergent governance arrangements with regulatory frameworks capable of supporting these approaches. This paper presents empirically informed insights from the interface between the practice, science and regulation of ecological restoration. Data from in-depth interviews with 34 restoration experts from across three Australian regulatory jurisdictions forms the basis of a comparative case study that investigates the extent to which regulatory frameworks are capable of supporting key elements of adaptive governance. Drawing on the interview data, this paper makes findings on the operation and effectiveness of adaptive approaches within the case study regulatory frameworks. With insights relevant to regulatory reform concerned with enhancing conservation and the prioritization of social and ecological recovery, this comparative case study demonstrates that regulation for recovery requires more than 'adaptive' approaches. To have regulation for recovery, regulation must comprehensively reflect and enforce the value of functioning, complex and biodiverse socio-ecological systems, recognize the value and importance of community knowledge, input and participation, and regulate in accordance with social-ecological temporal and spatial scales.

Introduction

Ecological restoration has gained significant global attention as a response to the consequences of resource extraction, biodiversity loss and climate change. At an international level, the United Nations General Assembly has declared 2021-2030 the decade of ecosystem restoration, in response to ongoing biodiversity loss and land degradation.[18] At the national level in Australia, a recent review of the signature federal conservation legislation, the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act), found that the EPBC Act was unable to halt environmental decline or manage cumulative impacts (Samuel 2020). The *Samuel Report* (2020) identifies a key reason for this failure as the absence of comprehensive regulatory frameworks for facilitating restoration in Australia. This failure is not limited to the EPBC Act. Despite the attention afforded to ecological restoration, the governance (including regulatory) arrangements to facilitate its practice globally are still in their infancy (Aronson and Alexander 2013; Palmer and Ruhl 2015; Richardson 2015; Telesetsky 2013; Telesetsky et al. 2016). Regulation in Australia has, to date, largely been concerned with the rehabilitation of discrete geographical areas; for example, the rehabilitation of a mine site, remediation for pollution, or the conservation of a particular threatened species (Richardson 2015; 2017).

The relationship between regulation and ecological restoration practice is an emerging field of research, with scholarship that has made significant normative and theoretical contributions (see amongst others: Akhtar-Khavari and Richardson 2019; Richardson and Lefroy 2016; Richardson 2016; Telesetsky et al. 2016; Telesetsky 2013; Hayes 2002; Palmer

[18] See UNEP and FAO, *United Nations Decade on Ecosystem Restoration 2021-2030* (webpage: https://www.decadeonrestoration.org).

and Ruhl 2015; Aronson et al. 2009). Due to the high levels of uncertainty and complexity inherent to the process of ecological restoration (Weinstein, Litvin, and Krebs 2014), the international Society for Ecological Restoration and others have called for adaptive approaches in its management (Aronson et al. 2009; Gann et al. 2019; Hodge and Adams 2016b; Nagarkar and Raulund-Rasmussen 2016; Samuel 2020; Smith 2020). This requirement has started to take hold not, only in the literature, but also in regulatory frameworks for ecological restoration. There is, however, little empirical research on the relationship of regulation and ecological restoration within Australia specifically. Notable exceptions concern mine rehabilitation and closure (see for example: Mills 2022; Vivoda, Kemp, and Owen 2019; Unger, Everingham, and Bond 2020; Bainton and Holcombe 2018; Bond and Kelly 2020; O'Faircheallaigh and Lawrence 2019; Kung, Everingham, and Vivoda 2020), marine restoration (Shumway et al. 2021; Bell-James and Lovelock 2019; Bell-James 2022) and wetland restoration (Gardner and Jensen 2016). Limited research on Australian jurisdictions considers the relationship between regulation for ecological restoration and adaptive approaches. This paper contributes to this research gap by presenting a comparative analysis of three regulatory case studies, each of which has differing regulatory arrangements and management objectives. The three case studies are mine rehabilitation and closure (MR&C) in the state of Queensland, Australia (Case Study 1), forest restoration in the state of Tasmania, Australia (Case Study 2), and regulatory arrangements for landscape restoration across both federal and state jurisdictions in Australia (Case Study 3). This paper draws upon in-depth semi-structured interviews with restoration experts from across Australia to examine to two key questions: (i) to what the extent does each regulatory framework exhibit adaptive governance characteristics; and (ii) is an adaptive governance

approach an appropriate regulatory response to achieve recovery of socio-ecological systems?[19] Four key characteristics of adaptive governance are identified and the case studies are evaluated against the extent to which they adopt these four key characteristics: (i) iterative learning, (ii) stakeholder engagement and participation, (iii) multi-scalar institutions and (iv) regulatory accountability. This research examines the regulatory arrangements and frameworks for restoration, but does not measure biodiversity markers, social determinants, ecosystem function or other recovery indicators to compare recovery and regulation. As a result, it cannot conclusively answer the question of whether adaptive approaches to regulation have a causative relationship to ecological recovery. Instead, this research is guided by the experiences of the participants and their input into the comparative case studies.

The research topic: restoration, recovery and regulation

Ecological restoration is defined by the international Society for Ecological Restoration (SER) as the 'process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed' and a process that 'aims to move a degraded ecosystem to a trajectory of recovery that allows adaptation to local and global changes, as well as persistence and evolution of its component species' (Gann et al. 2019, s7). Full recovery of an ecosystem is 'the state or condition whereby, following restoration, all key ecosystem attributes closely resemble those of the reference system' (Gann et al. 2019, s7). Ecological

[19] Social-ecological systems are integrated and interdependent complex systems, which, as a concept, does not delineate between the social and natural, but rather recognizes these systems as dynamic and relational (Berkes and Folke 1998; Biggs et al. 2021).

restoration should not assume restoration to a replica environment, as landscapes are dynamic, but rather envision an ecological system that is historically informed, with ranges of variability and multiple potential trajectories (Higgs et al. 2014). Recovery requires consideration of species composition, as well as ecosystem functioning, resilience, adaptive capacity, services and processes that support biodiversity in the achievement of recovery. Principle 6 of the international SER standards states that practitioners of ecological restoration will seek the highest level of recovery attainable and provides guidance on both social and ecological recovery, despite the definition of recovery being limited to the ecological elements of an ecosystem (Gann et al. 2019). Principle 8 recognizes that ecological restoration forms part of a continuum of restorative activities, culminating in the full recovery of native ecosystems (Gann et al. 2019). The SER reserves the term 'restoration for the activity undertaken and recovery for the outcome sought or achieved' (Gann et al. 2019, s7); this paper adopts the same terminology and distinction.

Ecological restoration as a practice is informed by both the science of restoration ecology and social acceptability (Higgs 2003), with governance (and the formal regulatory arrangements) integral to its definition, operation and success (Telesetsky 2013; Richardson and Lefroy 2016; Wyborn and Dovers 2014). As ecosystems can take decades or centuries to be restored, the SER and other scholars note the importance of effective monitoring, oversight and evaluation in avoiding costly mistakes (Nilsson et al. 2016; Gann et al. 2019). Adaptive approaches are widely recommended, particularly in the planning and management of landscape-scale ecological restoration projects (Aronson et al. 2009; McDonald, Jonson, and Dixon 2016; Cabin 2007; Hodge and Adams 2016; Nagarkar and Raulund-Rasmussen 2016; Simenstad, Reed, and Ford 2006). Principle 5 of the SER

international standards sets out an adaptive management approach in which the practice of restoration is guided by site characteristics and the relationship of the site with socio-ecological systems, including climate, landscape function and community (Gann et al. 2019; see also Bakker, Delvin, and Dunwiddie 2018; Hodge and Adams 2016; Smith 2020). Principle 1 encourages stakeholder engagement, while Principle 2 acknowledges that a diversity of knowledges are required for ecological restoration, including local and traditional ecological knowledge (Gann et al. 2019, S10).

Adaptive management is a management method for socio-ecological systems that requires continuous monitoring, evaluation and adjustment in response to uncertainty. It does not necessarily incorporate the social and collaborative aspects of socio-ecological systems, which adaptive governance seeks to do (Hurlbert 2018a). By comparison, adaptive governance recognizes that socio-ecological system management and uncertainty management are not just about applying scientific know-how, but also involve reconciling value judgments, social and ecological trade-offs, acknowledging multiple ways of knowing and understanding, resourcing and economic costs, management succession, and multi-level policy and regulation (Brunner 2005; Folke et al. 2005; Huitema et al. 2009). This paper acknowledges that ecological restoration is a social practice as much as it is scientific practice (Elias, Joshi, and Meinzen-Dick 2021; Egan, Hjerpe, and Abrams 2011; Fischer et al. 2021; Martin 2017) and therefore considers adaptive governance a more comprehensive approach for ecological restoration. This paper examines the three regulatory case studies to determine the extent to which they adopt adaptive governance and whether interview participants believe that adaptive governance approaches have a positive effect on social-ecological recovery. While adaptive governance seeks to include the entire governance

system (including informal and formal structures, processes and institutions), this research focuses primarily on regulatory institutions.

The relationship between ecological restoration and adaptive governance is addressed in a handful of studies. Schultz et al. (2015) examine a wetland restoration in Sweden for their case study analysis of adaptive governance, as do Hodge and Adams (2016) in their survey of restoration projects in the United Kingdom. On the whole, however, systems approaches to governance are an under-theorized and applied area in ecological restoration (Weinstein, Litvin, and Krebs 2014).

In relation to the literature on adaptive governance, the focus tends to be on community-led, bottom-up initiatives, rather than on formal rules and structures (Brosius, Tsing, and Zerner 2005; Hurlbert 2018a; Weber 2003). Existing research largely neglects top-down, strategic and state-based environmental regulation, as it is not considered to match ecological complexity or provide effective solutions for uncertain resource environments (Cumming, Cumming, and Redman 2006; Young 2002). This not only results in a research gap, but also a continuing regulatory gap, as strategic-level regulatory responses fail to support the emergence of local responses. Regulation can provide the opportunities for emergent local self-governance of socio-ecological systems (Ostrom 2005) but, without a statutory mandate, state institutions are unlikely to regulate in accordance with adaptive governance approaches (Wyborn and Dovers 2014). The emergence of localized, bottom-up adaptive governance is ad hoc and is not happening sufficiently swiftly to combat environmental decline (Cosens et al. 2021). Regulation, therefore, has a key role to play in facilitating and operationalizing adaptive approaches and orientating environmental management towards

the public good (Chaffin, Gosnell, and Cosens 2014; Cosens et al. 2014; 2021; Nagarkar and Raulund-Rasmussen 2016; Ostrom 2005; Wyborn and Dovers 2014).

While there are multiple definitions of regulation, this paper adopts the following definition from Baldwin et al. (1998, 3): regulation is 'an authoritative set of rules, accompanied by some mechanism, typically a public agency, for monitoring and promoting compliance with these rules'. Vivoda et al. (2019, 410) define a regulatory framework as an 'underlying structure used by states to develop networks of rules, laws and regulations, and to control or govern behaviour'. While regulatory scholarship seeks to broaden this definition by recognizing regulation and regulatory spaces as having multiple different actors all engaged in the regulation of each other (Parker and Haines 2018; see also Baldwin, Cave, and Lodge 2011; Levi-Faur 2011), this paper focuses primarily on the rules and agencies of the state in line with the research question: to what extent have regulatory frameworks adopted adaptive governance characteristics and is this an appropriate regulatory response?

Method

To answer the research question, this paper undertakes a case study analysis using data from participant interviews, and identifies four adaptive governance characteristics for comparative analysis across the three case studies.

Case study approach

To investigate the role of regulation in enhancing recovery, this paper presents an interdisciplinary comparative analysis of three regulatory case studies across Australian

jurisdictions. Case study research is 'empirical inquiry about a contemporary phenomenon (e.g., a "case"), set within its real-world context' (Yin 2009, 18). Examining the context and complexity of the 'case' is essential to understanding the phenomenon. In-depth analysis allows the researcher to corroborate or falsify existing concepts or theory or to develop new theory (Baxter 2010). The comparative element involves analyzing the attributes of two or more cases that share a common focus or objective, including their similarities, differences and processes (Yin 2014; Pahl-Wostl, Basurto, and Villamayor-Tomas 2021). In this paper, four characteristics of adaptive governance are applied for the comparative analysis. Case study research is particularly applicable to descriptive and explanatory research questions. As Duit et al. (2010, 364) argue, 'Analyses of governance and complex systems can gainfully be conducted using qualitative and case-study approaches'. The case study approach has been used in studies on socio-ecological systems (Basurto 2013; Epstein 1991), including ecological restoration law (Akhtar-Khavari and Richardson 2019b), multilevel planetary boundary governance (Galaz et al. 2012; Nilsson and Persson 2012; Reischl 2012) and in identifying emergent institutional dynamics of environmental regimes (Young 2010).

Here, the research approach is adaptive, with mutual dependency upon theory, qualitative data and doctrinal research (Layder 2021). The comparative case study is informed by complexity theory, qualitative interviews with research participants and regulatory/doctrinal research that investigates the regulatory frameworks of restoration. The research approach is reflexive, with both inductive and deductive reasoning, appropriate for both descriptive and ontological analysis which asks what is occurring and why it is occurring (Layder 2021).

Data collection

Key practitioners in ecological restoration across the three case study jurisdictions were approached to be interviewed for this research. Participants were identified using a combination of purposeful sampling and snowball sampling, both forms of non-probability sampling. In purposeful sampling, participants are directly identified by the researcher as being important to the project (Patton 2015). For this sampling approach, experts and practitioners in ecological restoration were identified from desktop research of the case studies or as authors of key policy or regulatory documents related to ecological restoration. In snowball-sampling, participants are asked to suggest colleagues who might be willing or appropriate for the study (Campbell, Taylor, and McGlade 2017). Snowball sampling is particularly useful for identifying key practitioners with knowledge and extensive experience. Suggestions made by participants were added to the sample, where it was practical to do so.

Throughout the sampling process, there was an attempt to ensure representation from participants across the following three contexts:

(1) strategic practitioners involved in the strategic planning side of ecological restoration initiatives within the three case studies;

(2) policy and regulatory experts within the three case studies; and

(3) implementation practitioners; that is, personnel (including local and community members) involved with the on-ground implementation of ecological restoration initiatives across the three case studies.

Participants in Case Study 2 and 3 included representatives from the three representation contexts. Participants in Case Study 1 were consultants, academics, departmental representatives, and non-government organization (NGO) personnel but did not include industry personnel (who did not respond to interview requests).

Each participant was invited to participate in a one-on-one, one-hour interview. Interviews were conducted either in person or by tele-conference depending on the participant's location, the Covid-19 restrictions at the time, and the preference of participants. An interview is defined as the elicitation of research data through the questioning of respondents (Wengraf 2001). Interviews conducted for this research were qualitative and 'semi-structured' or 'in-depth' interviews. Interviews of this kind have a more informal, conversational character, shaped partly by the interviewer's pre-existing interview guide, themes that emerge during the interview, and the experience and interest of the participant. Interviews were recorded digitally (with the consent of the participants) and transcribed. In total, some 37 participants were interviewed; of these 34 interviews were then transcribed verbatim and imported into NVivo 12 software to support the organization and analysis of the data through the adaptive theory approach and to code the data collected. Initial coding involved reading through the transcripts of all files and selecting text for coding. Codes were a mix of emergent and pre-assumed codes, primarily focused on themes emerging from the data, along with observations and topics. Codes were then checked for replication, before more focused coding organized codes into categories and themes. Four parent codes were then built, in line with the adaptive governance characteristics identified below.

Key characteristics of adaptive governance

While adaptive management shifts the focus away from future environmental risk assessment to processes that require continuous monitoring, evaluation and adjustment in socio-ecological system management, it does not comprehensively incorporate the social and collaborative aspects of socio-ecological systems (see Hurlbert 2018 for a comprehensive account of adaptive management and adaptive governance and the distinctions between them). By contrast, adaptive governance includes consideration of social and cultural conditions for the application of adaptive management. Governance is also conceptually different from management. While management has been defined as 'the processes of decision making, coordination and resource deployment that occur within a given institutional setting assuming no change in rules and norms' (Hatfield-Dodds, Nelson, and Cook 2007, 3), governance considers the exchanges between formal (legal processes and structures) and informal institutions (traditions, norms, rules, processes and structures) in the making of decisions, exercising responsibility, power distribution and accountability in the development, management and distribution of shared resources (Hurlbert 2018a, 23; Lebel et al. 2006; Cvitanovic et al. 2015). Governance involves political, legal, social, economic and administrative institutions from public, private and civil society (Hurlbert 2018a; Cosens et al. 2017).

There are many diverse definitions of adaptive governance. Consistent across the definitions is its appropriateness for a regulatory environment where there is scientific uncertainty about impacts upon socio-ecological systems and future demands (Karpouzoglou, Dewulf, and Clark 2016; Hurlbert 2018a; Folke et al. 2005) and that it recognizes multiple ways of knowing and understanding (Brunner and Steelman 2005). Adaptive governance is said to

have particular applicability to tightly woven and interconnected human and biophysical systems (Dietz, Ostrom, and Stern 2003) in that it mediates human interactions with ecosystems, resulting in a 'range of interactions between actors, networks, organizations, and institutions emerging in pursuit of a desired state for social-ecological systems' (Chaffin, Gosnell, and Cosens 2014, 61). Adaptive governance is considered to be a paradigmatic shift from a singular approach, which seeks to govern singular parts of an ecosystem, to one that seeks to understand and respond to the dynamism and uncertainty of the socio-ecological system (Gunderson and Holling 2002; Chaffin, Gosnell, and Cosens 2014; Dietz, Ostrom, and Stern 2003; Folke et al. 2005; Olsson et al. 2006).

Elements of adaptive governance commonly identified in the literature include collaborative and social learning-based management across different scales (Folke et al. 2005; Gunderson and Holling 2002; Hurlbert 2018a; Olsson et al. 2006; Wyborn and Dovers 2014), continuous learning by interpreting and responding to ecosystem feedback and stakeholder participation in policy making (Hatfield-Dodds et al. 2007) and flexible institutions and social networks in multi-level governance systems to improve the adaptive capacity of a system to respond to uncertainty, surprise and external drivers (Berkes and Folke 1998).

This research identifies four key characteristics of adaptive governance from the literature: (i) iterative learning; (ii) stakeholder engagement and participation; (iii) multi-scalar institutions; (iv) and regulatory accountability. These four characteristics are applied to the regulatory case studies to evaluate the extent to which ecological restoration regulation is adopting adaptive governance principles and approaches. The comparative case study analysis allows for an exploration of whether adaptive governance approaches within the case studies are assisting in social-ecological recovery.

Iterative learning

Environmental regulation generally prioritizes front-end processes to predict and assess environmental harm in a balancing act with economic growth, national interests and social equity (Philippopoulos-Mihalopoulos 2011b; Ruhl 2012; Vivoda, Kemp, and Owen 2019). Regulatory mechanisms, such as environmental impact assessments (EIAs), are usually upfront, rigid and continue an ontology of prediction and control, often failing to integrate uncertainty and respond to social and ecological change (Holling and Meffe 1996; Noble 2000). In response, iterative learning, or 'learning by doing' has been put forward as a suitable approach to ensure that there is ongoing monitoring and evaluation of socio-ecological systems (Pahl-Wostl et al. 2007; Folke et al. 2005), including in relation to ecological restoration (Gann et al. 2019, s16). Iterative learning requires an initial assessment of the context, problem and desired objectives of a socio-ecological system and prediction of the expected impacts of actions. It requires processes to support the adoption of provisional legal, policy and institutional frameworks, including management plans which will inform the ongoing monitoring and collection of information, as well as periodic assessment to determine the effectiveness of the approach with modification of the framework, if required (Cosens et al. 2017; Schramm and Fishman 2009; McDonald and Styles 2014). Iterative learning can be included in regulatory systems (Cosens et al. 2017; Schramm and Fishman 2009; McDonald and Styles 2014) and is considered key to adaptive governance and processes (Garmestani and Allen 2014).

Stakeholder input and public participation

Adaptive governance aims to foster strong collaboration and power-sharing between managers, experts and stakeholders, including local communities, and is considered an

essential part of social learning (Folke et al. 2005). Stakeholder input and public participation is particularly important in post-normal systems; that is, systems where 'facts [are] uncertain, values in dispute, stakes high and decisions urgent' (Funtowicz and Ravetz 1993, 744). Collective decision-making is encouraged by adaptive governance scholarship (Dietz, Ostrom, and Stern 2003), with a broad range of environmental actors, organizations, and communities said to increase legitimacy, transparency and accountability, as well as increase flexible and responsive governance and innovation (Folke et al. 2005; Huitema et al. 2009; Young 2017). But with the rise in private governance as a form of self-organization, Cosens et al. (2019) identify a need to ensure that powerful interests do not capture decision-making and that responsive decision-making is institutionalized. Regulatory arrangements should be established early in the project planning to identify relevant stakeholders and facilitate stakeholder participation (Young 2017).

Stakeholder input and participation has, however, been identified as burdensome, time- and resource-consuming, and can delay necessary environmental actions (Wyborn and Dovers 2014). The challenge for regulatory systems is to achieve a balance between meaningful engagement and participation and flexible and adaptive decision-making, with Craig and Ruhl (2013) recommending that public input be sought at key stages, rather than throughout the entire process.

Multi-scalar institutions

Scale is a critical element of adaptive governance. From a regulatory perspective, it is essential that processes be implemented at an appropriate scale (Garmestani, Allen, and Cabezas 2008) to contribute to accountability and legitimacy (Huitema et al. 2009). Dietz, Ostrom and Stern (2003; see also Ostrom 2007; 2010) contend that complex, multi-tier

nested institutional frameworks are required to address sustainability concerns where impacts are unevenly distributed across scales and a collective response is required. Multi-scalar approaches allow for the development of networks of people, ideas and knowledge (Innes and Booher 2010), while recognising the interdependence of actors, networks and institutions (Folke 2007) and the cooperation and integration required of such institutions across scales (Folke et al. 2005). The aim of integration is to transcend spatial and temporal scales, jurisdictional limits and land tenure requirements (Folke et al. 2005; Wyborn and Dovers 2014) to allow for co-ordinated responses to social-ecological systems. This integrated and multi-scalar approach is one way of increasing 'fit' between socio-ecological systems and governing institutions (Allen et al. 2011; Folke et al. 2007), with multi-scalar regulatory arrangements matching the spatial, temporal and functional scales of the system. The key question for this case study analysis is, therefore, whether the regulation for ecological restoration supports governance at the 'right' scale.

Regulatory accountability

Recognizing that regulation has a key role in facilitating and operationalizing adaptive approaches (Chaffin, Gosnell, and Cosens 2014; Cosens et al. 2014; 2021; Nagarkar and Raulund-Rasmussen 2016; Ostrom 2005; Wyborn and Dovers 2014), the final characteristic of adaptive governance is accountability. Regulatory systems have a fundamental role to play in designing conflict resolution mechanisms and resolving disputes over environmental resources to increase accountability and legitimacy of adaptive governance (Cosens et al. 2017; Walkerden 2006), as well as in the enforcement of environmental standards, protections and decision-making.

For this fourth characteristic, the focus is two-fold in relation to the ecological restoration case studies. First, regulation must establish processes for identifying outcomes of recovery and set indicators to measure success. Scholarship across the field of ecological restoration highlights the central importance of standards, for both mandatory and non-mandatory restoration, to optimize results, increase the capacity of regulators to set outcomes and monitor, as well as to avoid ecological restoration being overestimated as a form of compensation with respect to offsetting land and resource development (Gann et al. 2019; Higgs 2003; McDonald, Jonson, and Dixon 2016; McDonald and Dixon 2018). While standards that are too narrow are not suitable for adaptive processes, multiple articulated goals can be adaptive (Arnold and Gunderson 2014). This is evident in the SER international standards (Gann et al. 2019),[20] as well as in policy, such the rehabilitation hierarchy in Queensland. The second focus of regulatory accountability examines the enforcement of regulatory elements that operationalize adaptive governance characteristics. This requires an analysis of regulators' effectiveness in enforcing standards and objectives, stakeholder participation and iterative learning, as well as accountable actors and available remedies (Folke et al. 2005, 448).

Limitations

This research examines the regulatory arrangements and frameworks for restoration across the three case studies. The research does not measure biodiversity markers, social determinants, ecosystem function or other recovery indicators to compare recovery and

[20] Standards developed by SER and others are not intended to have regulatory significance in their own right. Instead, they are intended to guide regulators and others to resolve disputes and increase accountability (McDonald and Dixon 2018).

regulation, so cannot conclusively answer the question of whether adaptive approaches to regulation have a causative relationship to ecological recovery. Instead, the research is guided by the experiences of the participants and their input into the comparative case study. This is a limitation of the research, as it relies upon the normative judgement of the researcher and participants. It is also a strength, however, as it allows for the research to be guided by the knowledge and experience of the various participants.

Findings: the regulatory case studies

The regulatory arrangements for the sites of Case Study 1 (mine rehabilitation and closure (MR&C)), Case Study 2 (forest restoration) and Case Study 3 (landscape restoration) are set out below. While all three case studies have differing regulatory arrangements, objectives and institutions, all seek, in some way, to undertake restorative activities.

Case Study 1: Mine rehabilitation and closure – Queensland

Cast Study 1 focuses primarily on mine rehabilitation and closure (MR&C) in the state jurisdiction of Queensland, Australia. Multiple definitions of MR&C can be found across the mining sector and mine completion criteria vary widely across jurisdictions (Manero et al. 2020). The International Council on Mining and Metals (2019) defines MR&C as a process of planning and managing the decommissioning of a mine, the environmental rehabilitation of a mine (including mitigating mining impacts on the landscape and other legacy issues) with eventual relinquishment of the mining lease. Closure occurs when the government regulator releases the mine operator or owner from any liabilities and responsibilities associated with the mine.

Since the 1980s and 1990s, MR&C has come a long way towards ensuring that processes are in place to minimize environmental risks (Mills 2022; Unger, Everingham, and Bond 2020). Where it was initially concerned with simply re-establishing some form of vegetation cover and post-mining land-use, MR&C now includes the restoration of pre-existing ecosystems, as well as social elements (Gardner and Bell 2007; Trigger et al. 2008; Unger, Everingham, and Bond 2020). Manero et al. (2020) identify four widely applied MR&C principles across international, national and regional jurisdictions which seek to ensure that MR&C sites are: (i) physically/geotechnically stable, safe for both humans and animals; (ii) geochemically stable, as well as non-polluting and non-contaminating; (iii) capable of supporting post-mine land use; and (iv) capable of social and environmental sustainability that does not require ongoing active care.

At the federal level, resource exploration and development are regulated only where they concern protected matters of national environmental significance (MNES) under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) or where the national *Native Title Act 1993* (NTA) provides for the negotiation of agreements on access to the Indigenous native title estate. The EPBC Act provides that, if a mine is likely to have a significant impact upon a protected matter, the project must be referred to the relevant federal Minister for assessment and approval, with or without conditions. These conditions may include rehabilitation measures, bond requirements and other financial assurance mechanisms. Since the EPBC Act was enacted in 1999, 118 mining and resource projects have been approved; however, conditions have related largely to resource extraction, rather than MR&C (Environment and Communications References Committee 2019). Concern for

Commonwealth responsibility for MR&C led to a recent Australian Senate inquiry (Environment and Communications References Committee 2019).

At a state level in Queensland, the Department of Resources is responsible for mine licensing compliance, land access and abandoned mines, with mining authorized under the *Mineral Resources Act 1989* (Qld). The Department of Environment and Science is responsible for the environmental management of operating mines and overseeing site rehabilitation. Rehabilitation of mine sites is required under the *Environmental Protection Act 1994* (Qld) to reduce disturbance caused by authorized mining activities and to minimize potential future environmental harm. Mining proponents must apply for an environmental authority to conduct mine activities,[21] with the application detailing the proposed post-operation rehabilitation of the site in a Progressive Rehabilitation and Closure Plan (PRCP).[22] The Department of Environment and Science assesses the PRCP and rehabilitation for part (or the whole) of a surrendered mining project and signs off on mine closure certificates.[23]

Rehabilitation is informed by departmental guidelines and policy, which require the identification of 'suitable post-mining land uses having regard to the surrounding landscape, community views and the objectives of any local and regional planning strategies' (Department of Environment and Heritage Protection, Department of Natural Resources and Mines, and Queensland Treasury, n.d., 2). The *Strong and Sustainable Resource Communities*

[21] *Environmental Protection Act 1994* (Qld) s. 125(1).
[22] The Queensland Audit Office's (2013) review of Queensland's environmental regulation found that the environmental remediation of mines was 'an unrealised aspiration' with serious mine legacy concerns. State liability for MR&C failure was estimated at A$8.7bn in 2017 (Queensland Treasury Corporation 2017). The *Mineral and Energy Resources (Financial Provisioning) Act 2018* (Qld) amended the *Environmental Protection Act 1994* and introduced the requirement of PRCPs with the aim of reducing financial liability under the *Mining Rehabilitation Fund Act 2012* (Qld).
[23] *Environmental Protection Act 1994* (Qld) ss. 318Z, 264.

Act 2017 (Qld) requires mine operators to undertake a Social Impact Assessment to ensure that communities located near mines benefit from extractive projects and that ongoing engagement with these communities is detailed. Concern regarding MR&C and state liability has also led to the recent appointment of the Queensland Rehabilitation Commissioner, an independent statutory position to assist in developing best practice mine rehabilitation management.

MINE REHABILITATION AND CLOSURE					
Agency	**Federal Government**	**Department of Resources**	**Department of Environment and Science**	**Department of State Development, Infrastructure, Local Government and Planning**	**Office of the Queensland Mine Rehabilitation Commissioner**
Key regulation	*Environment Protection and Biodiversity Conservation Act 1999* (Cth); *Native Title Act 1993* (Cth); Native Title (Indigenous Land Use Agreements) Regulations 1999; Leading Practice Sustainable Development Program for the Mining Industry: Mine Closure 2016; Leading Practice Sustainable Development Program for the Mining Industry: Mine Rehabilitation 2016	*Mineral Resources Act 1989;* Mineral Resources Regulation 2013; *Mineral and Energy Resources (Common Provisions) Act 2014; Mineral and Energy Resources (Financial Provisioning) Act 2018;* Environmental Protection (Rehabilitation Reform) Amendment Regulation 2019; Mined Land Rehabilitation Policy; *Petroleum Act 1923; Petroleum and Gas (Production and Safety) Act 2004;Vegetation Management Act 1999.*	*Environmental Protection Act 1994; E*nvironmental Protection Regulation 2008; Environmental Impact Statement Process for Resource Projects Guideline 2015; Financial Assurance under the *Environmental Protection Act 1994* Guideline 2016; Triggers for Environmental Impact Statements under the *Environmental Protection Act 1994* for Mining and Petroleum Activities 2014.	*State Development and Public Works Act 1971; Strong and Sustainable Resource Communities Act 2017;* Preparing an Environmental Impact Statement: Guideline for Proponents 2015; Social Impact Assessment Guideline 2018	Appointed under *Environmental Protection Act 1994* Chapter 8A with functions set out in s444I.
Key responsibilities	Overseeing the operation of the EPBC Act; Regulation of matters of national environmental significance; Developing Native Title regulation; Establishing the National Native Title Tribunal which oversees the applications for and administration of	Mineral resource policy development; Planning, monitoring, implementation and review of mineral resource regulation; Responds to non-compliance.	Issues environmental authorities for environmentally relevant activities including mining activities; Assesses PRCPs; Issues mine closure certificates.	Coordinator-General oversees the Strong and Sustainable Resource Communities initiative; Develops guidelines and policy regarding social impact; Implements and reviews the *Strong and Sustainable Resource*	Engages with stakeholders and the community to raise awareness of mine rehabilitation matters; Produces technical reports on the best practice rehabilitation of land impacted by resource activities; Provides advice to the Minister on

	Native Title in Australia; Developing best practice guidelines for MR&C.			*Communities Act 2017*.	mine rehabilitation practices, outcomes and policies; Reports on mine rehabilitation performance and trends in Queensland.

Table 1: The regulatory framework for MR&C in Queensland, Australia

Case Study 2: Forest restoration – Tasmania

The regulatory framework for Case Study 2 aims to ensure the partial or full recovery of native ecosystems. Tasmania's forests are regulated under what is known as the Tasmanian forest management system, which has an overarching legislative and policy framework, with planning and operational processes. This system has been significantly informed by Australia's National Forest Policy Statement (Commonwealth of Australia 1992, 6), which sets out a nationally shared vision: 'the public and private native forest estate will be managed for the broad range of commercial and non-commercial benefits and values it can provide for present and future generations'. Regional Forest Agreements (RFAs) are an outcome of the National Forest Policy Statement, legislated through the *Regional Forest Agreements Act 2002* (Cth). The Tasmanian RFA is a long-term bilateral agreement and framework document between the Tasmanian and Australian Governments, first signed on 8 November 1997. In 2017, a variation to the RFA established a 20-year rolling extension, subject to the satisfactory completion of five-yearly reviews. The aim of the Tasmanian RFA, which informs the primary objectives of the Tasmanian forest management system, is to ensure ecologically sustainable forest management across all tenure in Tasmania, provide for the conservation of the environment and heritage values through the establishment and

maintenance of a comprehensive, adequate and representative (CAR) reserve system and ensure certainty of resource access for the forestry industry.

The Tasmanian forest management system is also informed by the *Forest Practices Act 1985* (Tas) which has as its objective to 'achieve sustainable management of Crown and private forests with due care for the environment and taking into account social, economic and environmental outcomes' (*Forest Practices Act 1985* (Tas) schedule 7). The forest management system through the RFA and the Forest Practices Act establishes a tenure-blind approach, regulated by the Forest Practices Code (FPC), forest practices plans (FPPs), Forest Practices Officers (FPOs), and independent oversight and reporting by the regulator, the Forest Practices Authority (FPA) (Department of State Growth 2021; Forest Practices Authority 2020).

It is under the FPC and the FPPs that the detail regarding restoration is primarily regulated. While restoration was not mandatory until 2020 under the FPC, FPPs are now required to set out the rehabilitation of forest coupes, with the sowing or planting of species similar to those of the natural canopy for the site, using seed from local or similar provenances (Forest Practices Authority 2020). Species selection should also consider the potential effects of climate change. Regeneration should restore the forest to its productive capacity and ecological condition, so that it contributes to future wood supply and ecosystem services in accordance with the principles of sustainable forest management. The Department of State Growth Tasmania (2021, 3) notes that the system is 'complemented by an adaptive management and continuous improvement process incorporating research findings and feedback processes associated with compliance and enforcement systems, stakeholder engagement and monitoring and review mechanisms'.

The practice of forest restoration in Tasmania is substantially informed by market-based certification schemes. For example, all plantation companies operating in Tasmania are certified under the Australian Forestry Standard and/or the Forest Stewardship Council. The public land manager, Sustainable Timber Tasmania, is currently seeking certification with forest restoration recognized under both standards across multiple principles and criteria, including soil and water, high conservation values and stakeholder engagement (Schofield 2017). This industry practice has influenced regulatory standards.

FOREST RESTORATION, TASMANIA					
Institution	**Department of State Growth**	**Department of Natural Resources and Environment**	**Forest Practices Authority**	**Sustainable Timber Tasmania**	**Private Forests Tasmania**
Key regulation	*Forestry (Rebuilding the Forest Industry) Act 2014;* Permanent Native Forest Estate Policy; Tasmanian Regional Forest Agreement	*Nature Conservation Act 2002; National Parks and Reserves Management Act 2002; Crown Lands Act 1976; Threatened Species Protection Act 1995; Historic Cultural Heritage Act 1995; Aboriginal Heritage Act 1975; Environment Management and Pollution Control Act 1994; Biosecurity Act 2019;* Tasmanian Reserve Management Code of Practice	*Forest Practices Act 1985;* Forest Practices Regulations 2017; Forest Practices Code; *Threatened Species Protection Act 1995; Nature Conservation Act 2002;* Tasmanian Regional Forest Agreement; Permanent Native Forest Estate Policy	*Forest Management Act 1985; Forest Management Act 2013; Forestry (Rebuilding the Forest Industry) Act 2014;* Forest Management Act Ministerial Charter – Forestry Tasmania 2015	*Private Forests Act 1994*
Key responsibilities	Policy development; Monitoring, implementation and review of the Regional Forest Agreement	Collect information on Tasmania's natural and cultural values; Provide advice on the location and the management of these values; Manage formal reserves, Crown land, and 'Future Potential Production Forest' land in line with the Tasmanian Reserve Management Code of Practice	Implement and regulate the forest practices system by: Publishing the Forest Practices Code; Issuing forest practice guidelines and forest practice plans; Preparing State of the Forests Report every five years; Administering Private Timber Reserves	Manage the Permanent Timber Production zone land by: Planning and monitoring to ensure a sustained wood yield to meet minimum legislated supply; Planning, implementing and monitoring wood products supply; Sustainably manage non-wood values	Facilitate and expand the development of the Tasmanian private forest resource

Table 2**:** The regulatory framework of the Tasmanian Forest System (adapted from the Department of State Growth 2021).

Case Study 3: Landscape restoration – Australia

Case Study 3 relates to landscape-scale restoration across Australia and its regulatory environment. Landscape restoration has been defined simply as restoration that 'includes large, contiguous, or fragmented areas (equal to or greater than several km^2)' (Menz, Dixon, and Hobbs 2013, 526). Naveh (2005, 231) expands on this definition, stating that landscapes: 'serve as the spatial and functional matrix for all organisms, including humans, their populations, communities, and ecosystems'. Landscape restoration recognizes that landscapes and their ecological processes are inherently complex (Newman et al. 2019) and that landscape restoration seeks to consider a variety of scales, including the cross-habitat linkages and energy fluxes that exist across the landscape (Weinstein, Litvin, and Krebs 2014).

Generally, landscape scale restoration is non-mandatory, in that it is undertaken voluntarily, often by large landowners or NGOs, such as Landcare,[24] The Nature Conservancy[25] or Greening Australia,[26] within a quite limited regulatory environment. At the federal level, if the landscape restoration in question might impact MNES, proponents are subject to the regulatory processes under the EPBC Act and EPBC Regulations. This is particularly relevant where wetland restoration is occurring on the internationally recognized Ramsar sites,[27] for

[24] Landcare Australia, 'What do people involved in Landcare do?' (webpage: landcareaustralia.org.au/about/what-do-people-involved-in-landcare-do/ accessed 23 December 2022).
[25] The Nature Conservancy Australia, Reef Builder: Rebuilding Australia's lost shellfish reefs' (webpage: www.natureaustralia.org.au/what-we-do/our-priorities/oceans/ocean-stories/restoring-shellfish-reefs/ accessed 23 December 2022).
[26] Greening Australia, 'Our programs' (webpage www.greeningaustralia.org.au/our-programs/ accessed 23 December 2022).
[27] Sites recognised under the *Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat,* opened for signature 2 February 1971, 996 UNTS 245 (entered into force 21 December 1975).

example. If the landscape restoration is tied to carbon credit schemes or biodiversity offset arrangements, proponents will need to meet these regulatory arrangements. Various strategies and policies inform funding arrangements, including *Australia's Biodiversity Conservation Strategy 2010-2030*, amongst others.

At the state level, proponents undertaking restoration on public land need to navigate the regulatory requirements of those departments and statutory bodies that manage the land. On private land, restoration can usually be undertaken with the permission or at the instigtation of the landholder. If the landscape restoration is to be protected by a conservation covenant, proponents need to navigate that regulatory system. Some states have additional specific requirements. In Tasmania, for example, restoration activities on private land may be subject to the forest management system, if the restoration activities involve reforestation, and an FPP might be required. In the absence of formal regulatory standards, proponents are at liberty to adopt whatever standards they choose and may adopt the SER international standards as the leading standards for restoration in Australia.

LANDSCAPE RESTORATION, AUSTRALIA WIDE			
Agency	**Federal government**	**State government**	**Local government**
Key regulation	*Environment Protection and Biodiversity Conservation Act 1999; National Greenhouse and Energy Reporting Act 2007; Carbon Credits (Carbon Farming Initiative) Act 2011; Natural Resources Management (Financial Assistance) Act 1992;* National Landcare Program; Commonwealth Grants Rules and Guidelines 2017; Australia's Strategy for Nature 2019-2030; Australia's Biodiversity Conservation Strategy 2010-2030; Environmental Restoration Fund; *Australian Charities and*	Framework regulation for land use planning (see for e.g. the *Land Use Planning and Approvals Act 1993* (Tas)); Regulation for the management of conservation covenants (see for e.g. the *Nature Conservation Act 1992* (Qld) s. 45); Environmental and biodiversity offset regulation (see for e.g. the *Biodiversity Conservation Act 2016* (NSW))	Local planning laws

	Not-for-profits Commission Act 2012 (Cth); *Charities Act 2013* (Cth)		
Key responsibilities	Manage matters of national environmental significance; Oversee the development and regulation of the national carbon credit market; Provide funding for natural resource management; Overseeing the National Reserve System	Manage formal reserves and Crown land; Develop framework regulation for land use planning and set planning policies; Manage conservation covenants; Oversee environmental and biodiversity offset schemes; Undertake rehabilitation of degraded Crown land following development; Establish funding avenues for Natural Resource Management groups and Landcare bodies.	Oversee local planning and development; Manage local reserves

Table 3: The regulatory framework for landscape restoration in Australia.

Discussion

> *It's more to do with governance than biology whether we succeed or fail in these things. [Participant]*

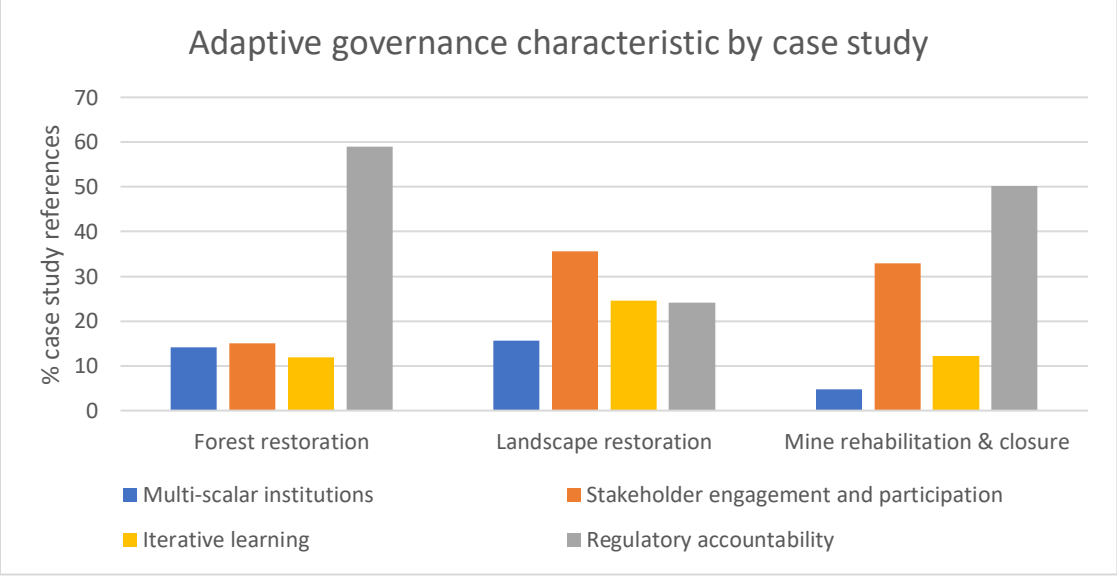

Figure 1: Participant focus on adaptive governance characteristics by case study.

The focus for the discussion is the extent to which adaptive governance characteristics have been adopted within the case studies, with comparison of the three case studies informing the findings on the influence of adaptive governance characteristics on recovery.

Regulatory accountability: Avoiding state liability, increasing standards and oversight, independent regulators

Regulatory standards and accountability formed a key discussion point for all participants, but was of particular interest in the MR&C and forest restoration regulatory case studies, as indicated at Figure 1. Participants from all three case studies identified issues regarding the regulatory standards for recovery. Where recovery was regulated, it was from a biophysical perspective, with indicators largely concerned with environmental conditions, such as ensuring stable and non-polluting landforms, or ensuring a certain level of ground and canopy cover. Participants noted reform on regulatory standards but that there continued to be limited consideration of the social and cultural elements of recovery. Enforcement and oversight of regulatory standards was another significant issue. Standards for MR&C and forest restoration were quite well established (see Tables 1 and 2); however, standards for landscape restoration were quite limited.

Participants in the MR&C case study noted that state governments across Australia have significantly reformed MR&C regulation to avoid the financial and environmental liability for inadequate MR&C.

> You know what was deemed to be the cost to close a site 10 years ago is a quantum different than what it is now. The numbers are that … for major sites … and what was touted to be a $10 million rehabilitation site is now $100 million because the reality is that once you actually crunch the numbers and find out what you need to actually close out that site, and then ongoing maintenance post closure, the costs are significant and industry knows that now. [Participant]

The financial and environmental liabilities of poorly closed mines can be substantial (Unger, Everingham, and Bond 2020; Roche and Judd 2017; Campbell et al. 2017; Bainton and Holcombe 2018; Mills 2022). Participants identified the progressive rehabilitation requirements and increased consideration of the environmental and social elements of mine rehabilitation as initiatives that aim to increase regulatory accountability and financial assurance in Queensland. Despite significant regulatory reform, most participants in this case study continued to have concerns regarding the regulator's ability to enforce those standards and undertake the long-term monitoring and management required for ecosystem recovery.

> From my perspective, regulatory hurdles are not difficult to overcome because I think … the regulator is very conservative and is quite accepting of a … relatively low standard ... I think [regulators] have probably come to accept the fact that they should be not necessarily asking for a gold-plated outcome. In many cases they are quite prepared to accept a – you know, a lead standard. [Participant]

Participants identified this lack of effective oversight as being due to several factors, including a lack of capacity by the regulator and regulatory capture. Participants noted that MR&C regulation has failed to keep pace with mining practice. Participants described circumstances where, in some cases, closure certificates were issued, despite MR&C not meeting the initial agreed post-use land use. Participants also set out examples of industry

practice that impacts successful MR&C, such as the relatively common practice of putting mines into 'care and maintenance'. This practice allows mining companies to avoid the financial costs of MR&C by 'mothballing' mines following active extraction with minimal investment in rehabilitation, thereby deferring mine closure (Vivoda, Kemp, and Owen 2019). Participants also identified examples of mining companies divesting mines nearing the end of their productivity to lower-capitalized companies. This often results in the purchasing company declaring insolvency, with liability for restoration transferring to the state (Owen and Kemp 2018). Additional regulatory issues arise from geomorphology and ecosystem function changes inherent to the process of mining itself. These changes might prevent the post-mine landscape from supporting a similar ecosystem or suitable post-mine land use (Lamb et al., 2015), resulting in extensive 'novel' ecosystems with limited social or ecological value (Erskine and Fletcher 2013; Gwenzi 2021; Erskine, Vickers, and Mulligan 2008; Lima et al. 2016; Doley, Audet, and Mulligan 2012). The Queensland Government has sought to address many of these concerns: in 2018 it passed the *Mineral Resources and Energy (Financial Provisioning) Act 2018* (Qld), which reformed the financial assurance arrangements and management of residual risk to limit state liability. The full impact of these reforms remains to be seen, but it is likely that there will continue to be concerns. As one participant succinctly summarized the situation:

> The way we regulate adapts to the industry. [Participant]

In comparison to MR&C and landscape restoration, many of the participants in the forest restoration case study were supportive of the oversight provided by the independent regulator (the FPA) and its capacity to regulate the permanent timber production estate. Forest restoration was being undertaken at almost 100%. While the FPC has only recently

set out more comprehensive restoration standards (Forest Practices Authority 2020), the various forest certification schemes, such as Forest Stewardship Council (FSC) and Responsible Wood, mean that forest operators in Tasmania have been undertaking reforestation for many years.

> FSC has been kind of useful in that they're acting as a sort of … compliance organisation at a high level. [Participant]

Potential legacy issues caused by the lack of regulatory accountability had been mitigated by market certification.

> I can't think of any forest company in Tasmania that's not practising forest restoration to some extent. [Participant]

Participants did, however, raise concerns about the standard of restoration required. Restoration standards, as set out in the FPC, are predominantly orientated towards forest production rather than recovery; standards with respect to social indicators are limited or non-existent.

Unlike MR&C and forest restoration, the regulation of landscape restoration has not established appropriate standards for recovery, or in many cases, any standards for recovery, let alone institutional oversight of the delivery of landscape restoration. Participants were generally quite supportive of standards, such as the SER international standards, but noted that the lack of standards meant that recovery was not being achieved.

> We don't have standards for what you're … producing … You get a market for lemons, and what that means is you're unable to create high quality outcomes. It's easier to create rubbish. So, almost all revegetation for restoration purposes is rubbish … Because of the market-for-lemons problem, not-for-profits step into the space and people virtue signal by investing … and then the

> not-for-profits perpetuate the market-for-lemons problem because that's how they make their … cut essentially ... There is no market for a high-standard revegetation, [or] there's a tiny market for that ... Restoration is hampered by the market-for-lemons problem due to a lack of institutional coordination that leads to a set of proper standards. [Participant]

Where funding was available for restoration under various government initiatives and programs, it was not consistently tied to accountability metrics. If there were key performance indicators or metrics, these were metrics such as stems per hectare or a tree survival percentage. Participants identified this lack of accountability as a concern.

> What we've seen in the last 20-30 years is that not-for-profits have stepped in where government has vacated the field … The trouble with not-for-profits is accountability. To whom are they accountable? They're not even accountable to their members ... if you look at the legislation, all it requires is that you must establish a membership. And that could be the board. You could limit the membership to the board … There are now about a dozen not-for-profits that manage around 9 million hectares of reserves. It's about 6% of Australia's national reserve system and growing faster than any state or public component of the National Reserve System. [Participant]

> One of the reasons that we set out to establish those [SER] standards was because you see so often poorly planned and executed rehabilitation restoration projects which are funded by government. And realistically, if groups are going to access government money, or to have a project kicked off by the government regulator, they should be meeting a set of common standards. [Participant]

Despite interest in market facilitation of landscape restoration, most participants noted that current regulatory standards in state established carbon markets were ill-fitted for recovery.

> They have the problem that the funding that comes from industry and from the government of the moment is to grow trees for carbon and growing trees for carbon is not restoration, it's plantation forestry ... we can grow 1000 trees a hectare and take their money for the initial stage … [and] their assessment is that, if half of the trees are alive after a year and a half, you've met the

> objectives. But that's just so short-sighted. That doesn't deal with the ecological reality of the environment the trees are growing in because the reality is you'll have huge attrition from that lot. You'll end up with 20-50 trees a hectare in 100 years and it would have been much better to grow 20 or 50 trees within cages so that the farmer can use the fields as something else. [Participant]

> I do worry … [about] the overwhelming emphasis on tree planting. So, despite the fact that I work in forests … I worry … what that could mean for some systems where, actually, whether it be peatland systems or grasslands … we could end up losing valuable systems due to too much emphasis on the tree planting kind of agenda. So, I think it's really important … what do we go for in certain landscapes. [Participant]

Iterative learning: Regulator capacity, long-term oversight and appropriate funding models for long-term management

Iterative learning was supported across all three case study sites by most of the participants interviewed. Elements of adaptive management were adopted in the forest restoration regulatory space, with at least a commitment to the principle of adaptive management in the regulation of MR&C and most landscape restoration. Despite the adoption of adaptive management, guidance on how to do it (in plans, codes, guidelines or other subsidiary regulation) was rare. The most significant challenge for iterative learning across all three cases is the long-term management required to support socio-ecological system recovery. As already noted, recovery can take decades, if not centuries, and long-term adaptive management is recommended to support the process. The regulatory frameworks for restoration are comparatively temporally limited. Only five to ten years of post-extraction or post-harvest management is required for MR&C and forest restoration, and government

funding and any oversight for landscape restoration is rarely allocated for more than three years.

In relation to the MR&C, case study participants noted that this lack of ongoing monitoring and adjustment have significant impacts upon recovery.

> From my day-to-day experience, I see that the regulator is quite good in picking out things like releases of contaminated water …. What promotes a far less immediate reaction is, you know, an eye on the progressive rehabilitation that's going on … Companies like Rio, they … do pay, I guess, more than lip service to that, because it's obviously in their shareholder public relations interest to do that. But smaller and medium-sized miners, they don't [care] … In a lot of cases, it's cheaper for them simply to walk away and forfeit a fairly small rehabilitation bond and leave the government to pick up the costs. I just don't think the regulator has enough of an eye on progressive rehabilitation. And I don't think they … have the skilled personnel to able to interpret … the kind of monitoring programs that should go on. [Participant]

> From what we know, there is not a real long-term active management effort in there. Weeds will get in. Fires are a regular constant issue out there. And these things can even change very quickly. And there just doesn't seem to be an effort to long-term active manage these things and mitigate those threats and ensure these areas are on the right path to make ecological restoration. [Participant]

The forest restoration case study participants noted that the regulator, due to its independence, long-term funding and commitment to the ethos of forestry, was committed to long-term planning and restocking forests for future production, but was limited in its temporal oversight.

> One of the issues … with biodiversity management over long timescales is that [the FPA] doesn't have much input or capacity to regulate beyond the life of a Forest Practices Plan. And, so,

> essentially once a Forest Practices Plan is signed off on after 5 years or whatever it is, [the FPA's] capacity to influence anything is greatly reduced … As a completely made-up example, if you asked for restoration in a Forest Practices Plan for something like hollow development, which you're talking about 110 years, as an offset, say, for something else, [the FPA] has no capacity to see that through … temporal management is really, really difficult. [Participant]

Participants also noted that iterative approaches to management are slow.

> The theory is that the results of the research are considered in review and development of the management of biodiversity issues and that completes that … adaptive management cycle where you develop something, train people up, you implement it, you monitor it, and then you adjust it. And that's the theoretical cycle of the forest practice system. It doesn't work quickly because research doesn't work quickly and even the reality of changing management doesn't work particularly quickly because you've got a whole load of considerations. [Participant]

For landscape restoration, the key barrier to iterative learning was funding arrangements.

> [Funding models are] unreliable and short term. And that's been the case ever since I've been involved in doing conservation land management – 35 years, it hasn't changed. It's a major problem. [Participant]

Participants noted that longer funding periods would assist in the roll-out of ecological restoration programs.

> If we could have 10-year plans, so that if there's a change of government, it doesn't matter that [the government] changes. That program is in place for 10 years and at the end of 8 years you go back and start renegotiating. But this two- or three-year funding, it's not long enough sometimes to even to get the benefit of a program. [Participant]

Long-term funding was very rare, however.

> A scientist getting funding from a funding agency for more than three years is almost a miracle. To get it for six was a miracle. [Participant]

Funding was predominantly limited to upfront project costs, with little funding available for ongoing management, administration or institutional capacity. This means that the resource costs of monitoring and ongoing management are often borne by the landholder (if restoration is done on private land) or by volunteer groups (if conducted on public land). As a result, ongoing management is often not done, leading to poor restoration outcomes, as identified by participants.

Multi-scalar institutions: integrated landscape planning, integrated institutions, and communication

Multi-scalar institutions integrate strategic and comprehensive national regulation with landscape-level planning that can capture and respond to place-specific ecological and social conditions. A key issue for most case study participants was national (strategic) to local (place-based) integrated multi-scalar institutions for restoration. This concern was in line with the *Samuel Report* (2020), which found that the lack of integrated regulation and planning for restoration is hampering conservation efforts and recommended integrated adaptive planning. Participants suggested that integrated planning could ensure that what would otherwise be restoration 'one-offs' could instead be coordinated across the landscape, allowing for increased species dispersion, ecological connectivity, biodiversity and ecosystem function. Some participants also noted that multi-scalar institutions should consider local community needs and social contexts in order to align landscape restoration with the social, economic and cultural requirements of local communities.

The parent code with the smallest number of references in the MR&C case study was multi-scalar institutions. This characteristic of adaptive governance was only minimally addressed in the discussions with MR&C participants, although participants did identify limited institutional integration and a lack of integrated planning for MR&C.

> This tender has just come out from the government about reviewing procedures and monitoring procedures and baselines. And part of that tender was looking at the feasibility of actually creating these wildlife corridors and joining up patches of rehab. So, there's definitely opportunities to upgrade areas and [be] strategic about which sites have the best opportunity to do that, but that that takes a really a broader approach, a regional approach or state-wide approach or even a national approach, rather than just local working with local, individual companies on their own sites. They might not even look what's happening across the road. [Participant]

This lack of consideration of multi-scalar integration likely reflects a long history of MR&C focusing on discrete processes and being limited to specific mine sites.

In the forest restoration case study, participants noted that there had been widespread adoption of a landscape planning approach, as forest managers sought to plan and restore across the state-wide permanent timber production estate. (Although ecosystem function and connectivity was only one reason for this approach, timber production was the other.) Landscape planning was supported by the regulatory space for forest restoration, particularly as the forest management system is tenure blind. Nonetheless, a number of participants noted challenges resulting from recent decisions to designate what was previously productive forest as reserves.

> I think one of the probably perverse outcomes of a huge growth in our reserve estate is that you run the risk of having the unreserved area – so, the production estate – [being] young stuff and

> old stuff and nothing in-between. So, you run the risk of having a landscape that's not heterogenous. [Participant]

The risk of homogeneity in the production estate was identified as being exacerbated by the legislated wood volume target under the *Forest Management Act 2013*, which requires Sustainable Timbers Tasmania make 137,000 cubic metres of saw log available each year.

> I imagine the pressure of trying to meet a legislative target when you've got a much smaller estate, and you've got a whole lot of other considerations – social, economic, environmental considerations – to make, is very, very challenging. And … how are you supposed to manage this legislated wood volume with things like climate change? It seems a crazy thing to have. [Participant]

In terms of multi-scalar institutions, forest restoration participants noted very little vertical integration but did identify some horizontal integration across the regulatory institutions. Participants noted personnel transfers across the various state agencies and identified informal, if not formal, communication and consultation pathways.

Landscape restoration participants strongly supported landscape restoration planning. Landscape restoration, by its very nature, requires consideration of the broader 'landscape' in which the restoration finds itself. Participants noted that, in practice, however, there were a number of barriers to landscape planning in regulatory frameworks, including land tenure, planning regulation and processes for social and local community engagement. The lack of institutional coordination from government for landscape restoration was also a significant barrier.

> It's not that those [community] efforts are not valuable; they make a contribution. But because they're not … transacted within a total framework of what we're trying to achieve, they are essentially just one – a long series of one-offs. Around those one-offs, we've developed a whole

> system substantially of not-for-profit agencies that perpetuate that system of a series of one-off restoration activities. [Participant]

Some participants argued that integrated institutions should not come at the expense of diminished standards.

> If you think about it just from an EPBC perspective, I just think it's so important not to devolve powers to the state because the state is pressured by a state budget and, particularly in places that don't have a lot of money like Tasmania or South Australia … you end up with state departments going against state departments and they require rigour. As an ecologist or regional ecologist for the department, it was so useful to have the federal government as a separate entity that you have to answer to because … all of the departments … come and go and they put the primary industries in with environment and water and the reality is those [industries] that make money will always top. And when you have that in the same department, it filters it right out. So, I think having that separation of powers is really important. [Participant]

Participants also noted the importance of integrating international strategies.

> The NRS [National Reserve System] was driven by our commitments to international treaties and particularly the Convention on Biological Diversity, which set, like, 10%, 70%, all those sort of targets, and what we did at the state level fed into the national targets. And even though, under some governments, there weren't necessarily strong commitments to those international [treaties] … Australia was seen as a lead player in that, and we didn't want to look too embarrassingly deficit … I don't think in the public perception that there'd be even any awareness of the influence of the Convention on Biological Diversity … and migratory conventions … but they actually play a very important role behind the scenes and can very much influence the financial side of incentives. [Participant]

Stakeholder engagement and participation: more than lip-service, ongoing and appropriately funded

Stakeholder engagement and participation is a well-established, key component of successful environmental management. Participants identified multiple benefits of this component, including increased accountability measures, reduced conflict, inclusion of diverse knowledges and perspectives, development of support for restoration activities, increased ecological literacy and, perhaps most importantly, restoration of culture and people to the landscapes in which they live. These benefits are well-established in the literature (Fernández-Manjarrés, Roturier, and Bilhaut 2018; Fleming et al. 2021; Gilfedder et al. 2021; Higgs 2005). Across all case studies, however, participants expressed concern that regulatory frameworks do not support effective and appropriate stakeholder engagement and participation, despite regulatory reform.

MR&C case study participants observed that recent regulatory developments which seek to address stakeholder engagement and participation (especially in relation to local communities) have done very little to increase stakeholder engagement and participation in MR&C. Stakeholder engagement has increased for resource projects, but only in relation to the front-end of the mine project. Long-term engagement is limited and opportunities for stakeholder participation in MR&C are uncommon.

Participants were also concerned about the limited opportunities for traditional owner and Indigenous stakeholder engagement in MR&C. As one participant stated bluntly:

> The mining industry pays nothing more than lip service to traditional owner involvement, opinion, resources, attachment. Need I go on? [Participant]

Participants noted that the focus on recreating pre-mining native ecosystems could preclude consideration of alternative land uses for social or economic development for local people post-mine closure, as well as the limited success of stakeholder engagement and participation standards in effecting alternatives to bio-physical rehabilitation/restoration.

> I've never been big on just broad-scale, one solution, but that's what seems to be locked in the mindset … at the moment, both with government policy and in the mining company … There's … attempts at native ecosystem restoration, whereas the mosaic landscape is what the TOs [traditional owners] want … You need a large proportion of trying to restore the native habitat. You're probably never going to succeed at absolutely achieving what was there, the biodiversity loss, but you can try and get something on track to being a functioning local native species ecosystem. But then, let's dedicate this zone to a timber plantation. Let's put a wetland here. Let's let them do the bush food garden over there. That, ultimately, for me … would be a better way to design the landscape from these mining impacts, and that's both from a TO perspective, because we've gotten that message from them. We've documented that. That's putting the right tree in the right place for the right reason. [Participant]

Participants largely held that stakeholder engagement and participation should be long term and ongoing, with appropriate resource allocation and funding. This lack of long-term engagement with stakeholders in MR&C is supported by the literature. In a review of the regulatory instruments concerning mine closure across New South Wales, Queensland and Western Australia, Vivoda et al. (2019) find that regulatory instruments broadly account for social considerations; however, this is without explicit legislative or policy guidance. Guidance as to the social elements of mine closure is limited to maximizing socio-economic opportunities (Vivoda, et al. 2019, 422); consideration of stakeholder engagement and participation is done primarily at the front end of the mine approval process. Following

approval, stakeholder-led engagement is relied upon, rather than undertaking monitoring and analysis. Vivoda et al. (2019) conclude that this contributes to unrealized mine rehabilitation, ultimately transferring the liability for mine closure to the state and onto the public. With many mines on or adjacent to the Indigenous estate, traditional owners bear the costs of mine closure failure (O'Faircheallaigh and Lawrence 2019; see also Annandale, Meadows, and Erskine 2021; Meadows, Annandale, and Ota 2019).

Forest restoration participants also reported that stakeholder engagement and participation is poorly supported by the regulatory frameworks for the forest restoration and that this is a key limitation of this system. The forest management system requires consideration of social, environmental and economic elements, but most participants noted an uneasy relationship between these three values. Social engagement and participation in the system is largely limited to formal regulatory processes, such as reviews of the Forest Practices Code or political engagement by advocacy groups.

> My sense was that … areas like cultural heritage and identifying remains of, you know, old huts or logging infrastructure – they were really good at that stuff. But … the things that they were never good at were the things [that] were simply problematic for sustaining the activities at hand. So, you know, social values around old growth forests or just the beauty of natural forests or social values that said we shouldn't be logging any natural forests anymore. There was no capacity to deal with that … so, there was always that compromise that had to be made, which meant that those people who had those values continue to be excluded in the process. [Participant]

Stakeholder engagement and participation was a key discussion focus for participants in the landscape restoration case study. They identified a range of stakeholder engagement and participation practices, including engagement with private landholders, the local community

and Indigenous and traditional owners, as well as special interest groups that could lead to political and financial support, education, buy-in from private landholders and assistance in the delivery of projects with volunteer labour. Participants were largely committed to long-term stakeholder engagement and participation, but noted that the process of building trust with communities took time and resources.

> One point I will make – and I reckon this is the most crucial point in a way – it takes about five years to get them to trust you and that is because they've seen so many other scientists come in, blow in, a little bit like seagulls…. The only way to get around that was to be seen to be there for the long haul and to give a lot of community talks, and when they want you to give a talk at the field and game on a Wednesday night, you go down and you do it. [Participant]

Funding models do not usually support this long-term development of trust. Funding awarded for education and outreach is often provided to support a 'one-off' event, rather than ongoing administrative or institutional capacity (Wyborn and Dovers 2014).

Conclusion

Regulatory frameworks face a number of challenges in effecting recovery of social-ecological systems across Australia. Regulation specifying the standards for recovery for both mandatory and non-mandatory restoration across the three case studies was found to be limited, with measurable criteria often non-existent. Regulation fails to deliver comprehensive planning and, with the exception of forestry restoration, ensure the long-term management and oversight of ecological restoration. Regulation for restoration and recovery is also poorly integrated, both jurisdictionally (from local to national levels of governance) and spatially (across the landscape). The characteristics of adaptive governance

have been implemented in only limited ways across the case study sites, with large gaps between principles and practice. However, participants noted that it is not necessarily the presence or absence of adaptive of adaptive governance that indicates successful ecological restoration, but rather the normative value assigned (or not assigned) to biodiverse social-ecological systems. Despite many of the gaps evident in practice, participants across the case studies reported that a number of adaptive governance characteristics have been adopted. As several participants identified, however, the recovery of socio-ecological systems will not improve until recovery and functioning socio-ecological systems are valued—not only from an economic perspective, but also socially and culturally.

> Restoration should be not just about the landscape. It should be systemic. It should be restoration of our governance. It should be restoration of our culture, if you will. So, we should be looking at restoration at a broad scale. [Participant]

It became clear that, even if the elements of adaptive governance were to be adopted in full by the relevant regulatory systems, the objective of recovery is not reflected in the regulatory frameworks for ecological restoration. Adaptive governance is a process that illustrates how socio-ecological systems can adapt to changing conditions and supports decision-making under high uncertainty (Karpouzoglou, Dewulf, and Clark 2016; Folke 2007; Cosens et al. 2019). It does not set the objective of a regulatory or governance system. This analysis demonstrates that objectives of the regulatory frameworks for ecological restoration do not currently facilitate functional, resilient and biodiverse socio-ecological systems. Rather, regulatory systems across Australia primarily facilitate land degradation through various forms of resource extraction. Ecological restoration is a practice adopted by these regulatory systems to limit the negative social, environmental and economic impacts of extraction.

Extraction and ecological restoration are tied to very different value frameworks: the pursuit of profit does not necessarily align (or rarely aligns) with the recovery of ecological and social wellbeing.

As analysis of the three case studies indicates, regulation that supports iterative learning, multi-scalar institutions, stakeholder engagement and regulatory accountability does go some way to facilitating socio-ecological recovery. The regulatory commitment to iterative learning across the three case studies indicates, however, that adaptive approaches to regulating restoration is not sufficient. To have functioning and biodiverse social-ecological systems, regulatory systems must place the objective of social and ecological wellbeing at the centre of their operation.

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Chapter 3

Chapter 3 investigates Research objective 4 of this thesis: To investigate the regulatory drivers for ecological restoration and consider the effectiveness of regulatory institutions for ecological restoration.

Following on from the findings in Chapter 2, it became evident that further institutional analysis was required to determine the drivers for ecological restoration within the regulatory frameworks. This chapter seeks to examine the setting of the regulation of ecological restoration in its political, legal and cultural contexts, with the aim of extending a systems approach to legal and regulatory research (Hancher and Moran 1989; Parker and Haines 2018). This approach was chosen to allow for the consideration of power mobilization and relations, which are inherently embedded in, performed by, and expressed in regulatory instruments (Ioris 2015; Hurlbert 2018b). Chapter 3 also adopts a social-constructivist definition of institutions as being social practices constituted by norms, conventions and formal rules and regulation, rather than consisting of rational, autonomous utility maximizers (Vatn 2005). Institutions in this definition are not static, as they can change over time and do not operate in isolation, as they can form conglomerates of institutional arrangements across scales (Petursson, Vedeld, and Vatn 2013). This approach to regulatory and institutional analysis continues into Chapter 4.

The institutional analysis method applied in this chapter is adapted from Hurlbert's (2018b) method, as set out in the *Adaptive Governance of Disaster.* The adapted approach explicitly considers regulatory institutions along with the regulatory instruments, the drivers of the institutions, and makes a normative decision about the effectiveness of the institutions in

line with the data collected. The final step of Hurlbert's (2018b) institutional analysis involves regulatory re-design and is considered in Chapter 4.

This chapter directly responds to Research objective 4 and continues the exploration of Research objective 2 (the investigation of the regulation of ecological restoration). The chapter makes four key findings regarding the drivers of regulation for ecological restoration, before theorizing with the concept of the environmental statehood (Ioris 2015) to situate the findings within a broader discussion of the ways in which neoliberal states approach social-ecological systems and environmental management.

The environmental statehood of ecological restoration: an institutional analysis of three regulatory case studies

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Abstract

Throughout Australia, social-ecological systems are in decline. Ecological restoration has been identified as a key process for reversing this decline, but the recovery of social-ecological systems following restoration is rare. As ecological restoration is a social practice as much as it is a natural science practice, regulatory frameworks have a key role to play in either promoting or impeding recovery. This chapter investigates how institutions in the regulatory space for ecological restoration approach recovery. It also identifies drivers for recovery through a multi-level institutional analysis of three regulatory case studies across Australia. This chapter ultimately demonstrates a paradox within ecological restoration regulation as the neoliberal ideologies prevalent in regulatory frameworks contribute to low recovery rates. Unless the drivers of ecological restoration shift from facilitating land degradation to facilitating social-ecological recovery, systems will continue to decline. The role of the state, state institutions and regulation is often overlooked in studies addressing socio-ecological resilience and adaptation, despite the central role of these institutions in the management of socio-ecological systems. This paper adds to the growing scholarship that addresses this research gap by contributing an empirically informed analysis, which explicitly considers the regulation of ecological restoration and the institutional arrangements in the regulatory space.

Introduction

Throughout Australia, social-ecological systems are in decline (Cresswell, Janke, and Johnston 2021). Ecological restoration has been identified as a key complement of

conservation or habitat retention for reversing this decline (Benayas et al. 2009; Kearney et al. 2020; Samuel 2020; Iftekhar et al. 2017). The recovery of social-ecological systems as a result of restoration processes rare, however. Despite being an economically viable solution (Bullock et al. 2011) and a process that has a critical role in increasing global biodiversity (Ehrlich and Pringle 2008), ecological restoration which results in recovery that matches the diversity, structure, ecosystem dynamics and function of reference systems is rarely achieved (Cooke, Bennett, and Jones 2019; Bullock et al. 2011; Jones et al. 2018; Suding 2011). Recovery in certain sectors remains an 'unrealized aspiration'; this failure is partly the result of the regulatory and institutional frameworks in place (Queensland Audit Office 2013; Samuel 2020; Vivoda, Kemp, and Owen 2019) .

While often framed as apolitical, ecological restoration cannot be understood as being outside social, political and economic relations (Hodge and Adams 2016a; Rai, Bhasme, and Balaji 2018; Scheidel and Gingrich 2020; Osborne et al. 2021). Questions of politics and ideology are at the very core of the regulation of land degradation and ecological restoration. This paper reports the results of a multi-level institutional analysis across three case studies in Australia, which was conducted to identify the arrangements of institutions and regulation for ecological restoration and the drivers for ecological restoration regulation in order to make a qualitative assessment of the effects of those drivers on recovery. With much regulation originating from the state[28] and state institutions, the discussion of the findings focuses predominantly on the way in which these institutions facilitate or hinder recovery.

[28] Here, the 'state' is understood as being 'a compulsory political organization … [that] upholds a claim to the monopoly of the legitimate use of physical force' (Weber 1978, 54) and also 'a process of exercising power via certain institutional arrangements' (Harvey 1976, 87). In the context of Australia's federal system, 'state' also refers to a sub-national unit of government; for example, the state of Queensland or the state of Tasmania.

This research is a theoretically informed, empirical analysis of the relationship between the ideology of environmental management and the regulatory environment for ecological restoration. Research of this kind is largely absent from the ecological restoration literature (notable exceptions include Dorondel, Şerban, and Tudor 2021; Hodge and Adams 2016a; Osborne et al. 2021; Rai, Bhasme, and Balaji 2018; Scheidel and Gingrich 2020). Indeed, analysis of the role of the state is often overlooked in studies addressing socio-ecological resilience and adaptation (Duit 2011), despite the state's central role in the management of socio-ecological systems (Ebbesson 2010; Ioris 2015; McCreary and Lamb 2014; Whitehead, Jones, and Jones 2007; Wyborn and Dovers 2014).

This chapter begins by setting out a brief explanation of the practice of ecological restoration and its goal: recovery. A review of the literature notes that ecological restoration outcomes are variable and often poor. The paper then investigates the drivers of ecological restoration and recovery from a regulatory perspective by applying a multi-level institutional analysis to the three regulatory case studies: Case Study 1 (mine rehabilitation and closure (MR&C) in Queensland), Case Study 2 (forest restoration in Tasmania) and Case Study 3 (landscape restoration across Australia). Following an explanatory account of the findings from the institutional analysis, this paper makes four key observations on the regulatory space for ecological restoration. First, institutions that regulate land degradation also seek to regulate restoration (particularly where restoration is a mandatory requirement, as it is for MR&C and forest restoration). Second, this dual function results in a regulatory framework that legitimizes land-degrading activities. Third, regulatory institutions primarily regulate ecological restoration to avoid state liability. Fourth, where ecological restoration is not mandated under the regulatory frameworks, analysis of the case studies demonstrates that

the regulatory development of the drivers of non-mandatory restoration are increasingly market orientated. The paper concludes by applying the theory and concept of environmental statehood developed by Ioris (2015) to the case studies to demonstrate the paradox in the management of environmental resources and the underlying ideologies prevalent in regulatory frameworks that are contributing to low recovery rates.

Ecological restoration and recovery

Defined as the process of 'assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed', ecological restoration 'aims to move a degraded ecosystem to a trajectory of recovery that allows adaptation to local and global changes, as well as persistence and evolution of its component species' (Gann et al. 2019, s6). Restoration is a process; recovery is its aim. This definition from the International Society for Ecological Restoration implies that there must be consideration of species composition, as well as ecosystem function, resilience, adaptive capacity, services and processes that support biodiversity to achieve recovery. Metrics of ecological restoration have moved away from singular attributes (such as carbon accumulation or taxonomic richness) in the assessment of recovery to more complex metrics that seek to assess the interactions between system components (Moreno-Mateos et al. 2020; Jones 2017).

There is widespread recognition that restoration is more than a natural science method and that it requires the involvement of social dimensions to effect recovery (Elias, Joshi, and Meinzen-Dick 2021; Egan, Hjerpe, and Abrams 2011; Fischer et al. 2021; Martin 2017). To that end, significant research on ecological restoration from a social sciences lens includes

the consideration of the normative goals of ecological restoration (Fischer et al. 2021), including the integration of social and ecological motivations (Jellinek et al. 2019), and the process of including social indicators in defining restoration and in monitoring systems (Martin 2017; Martin and Lyons 2018). Normative goal-setting and monitoring is linked to the research on the governance of ecological restoration projects and the decision-making processes that projects adopt or should adopt (Clement and Standish 2018; Gellie et al. 2018; Guerrero et al. 2017; Hodge and Adams 2016a; Nilsson et al. 2016). There has also been significant research into the legal and regulatory arrangements and principles for the delivery of ecological restoration (Palmer and Ruhl 2015; Bell-James, Boardman, and Foster 2020; Richardson 2016; Fidelman et al. 2019; Richardson and Akhtar-Khavari 2019; Richardson and Lefroy 2016; Telesetsky et al. 2016; Telesetsky 2013). Another key area of emerging research is ecosystem services and the monetary (and non-monetary) valuation of those services in the practice of restoration (Alexander et al. 2016; Benayas et al. 2009; Boerema et al. 2016; Ciccarese, Mattsson, and Pettenella 2012; Hughes et al. 2016; Jenkins et al. 2010; Tolvanen and Aronson 2016). Other authors focus on the cultural elements of restoration and the interplay of the practice with the human-nature relationship (Kimmerer 2011; Bartel and Graham 2019; Light 2003; Van Wieren 2008; Long, Tecle, and Burnette 2003). Research by scholars, such as Furness (2021), establishes that the human-nature relationship can be improved with participation in restoration.

Despite this significant research, financial and in-kind investment by governments and volunteer and community support, restoration outcomes remain variable and are often poor (Moreno-Mateos et al. 2020; 2012; Søndergaard et al. 2007; Wilkins, Keith, and Adam 2003). In a meta-analysis of 400 recovery case studies following disturbance, Jones et al. (2018)

found that, across a number of different ecosystems, complete recovery was very rare, with partial or limited recovery more common. Wilkins et al. (2003) compared the floristic composition and structure of 1000 hectares of pasture west of Sydney, Australia, which had undergone restoration treatment with untreated pasture, and failed to distinguish the composition of restored vegetation from that of the untreated pasture, both being significantly different from that of remnant vegetation. In their meta-analysis of 89 restoration studies, Benayas et al. (2009) found that, despite an increase in biodiversity and ecosystem services (by 44% and 25%, respectively), the biodiversity and ecosystem services values of restored sites were below that of reference sites. In response to these low rates of recovery, Suding (2011, 473) observes that, '[A]lthough restoration is often possible and results in net positive benefits, it often does not go as well as planned. The inability to meet set criteria in many projects occurs at a high enough frequency to bring into question our ability to set realistic goals and our confidence in meeting these goals'. This chapter investigates the influence of the regulatory space on the planning and objectives of ecological restoration and identifies the drivers of regulation for ecological restoration in order to present potential reasons for regulation's failure to arrest low recovery rates.

Methodology

Acknowledging that environmental law and regulation research can often be circumspect about its methodology (Murphy and McGee 2015; McGee and Steffek 2016; Fisher et al. 2009), the research design and method of this paper has been carefully considered. Here, I set out the theoretical approach to the research, before detailing the multi-level institutional analysis below.

Approach

First, the research method is reflexive, with mutual dependency upon theory, empirical data, doctrinal and regulatory research (Layder 2021). This paper follows the adaptive theory model of research proposed by Layder (2021), which allows for explicit consideration of ontological questions, or questions regarding the social reality—an approach necessary for any exploration of the underlying ideologies of regulation and institutions. This interdisciplinary approach sets out three elements necessary for research that investigates questions of social reality: (i) a generalizing frame which is a universal model of the social reality; this more global frame operates in dialogue with (ii) a local frame which is particular and an empirically informed image of the social reality as detailed from the data; and (iii) a reconciliation of these two frames through integrating both theory and method that prioritizes explanation over description (Layder 2021). This integration of theory and method is evident in the conclusions of this paper on the environmental statehood of ecological restoration.

Second, this paper adopts a social constructivist model of institutions. According to Vatn (2009b), the main role of institutions, constituted by legal rules, norms and conventions, is to indicate what is and is not appropriate behaviour. Individuals are socially created, with norms and values having their origin in societal institutions. Institutions help individuals to determine *what is* (what we have learned to observe) and *what should be* (the normative lens of what we have learned to respect); that is, 'institutions are both external rules and constructs that shape the individual' which are internalized through social construction (Vatn 2009b, 2208). This social constructivist model accepts that some things should not be traded and that ethical issues are distinct from commodity concerns. Vatn (2005) contrasts

the social constructivist model with what he calls the neoclassical model. This model, prevalent in neoclassical and neoliberal economics, views individuals as *autonomous utility maximizers* who have full information, and maintains that there are no transaction costs and that resources are privately owned, with markets governing their allocation (Vatn 2005). The neoclassical approach assumes that individual preferences are independent of the institutional context and, from a legal perspective, there exist independently authorized rules that apply to rational persons (Davies 2022). Behavioural research has shown that the neoclassical model is extremely limited. Individuals in different institutional contexts undertake different rationalities and make decisions with values and consideration of the broader social context in mind (Ostrom 2000; Vatn 2009a).

Third, in situating regulation as the research focus, this chapter examines the setting of the regulation of ecological restoration in its political, legal and cultural contexts, in an attempt to extend a systems approach to legal and regulatory research (Hancher and Moran 1989) and allow for questions of the social reality to be explicitly considered. As Parker and Haines (2018, 146) write:

> Regulation is not just standard setting or rule making, but also the framing of the regulatory agenda and setting objectives; the implementation of rules within targets; the gathering of information and monitoring behaviour; responding to non-compliance via sanctions and other forms of enforcement; and evaluating policy and providing feedback, including review of rules.

The historical timing, institutional and organizational structure, markets, social values and the nature of an issue all result in shaping the 'regulatory space' and the allocation of power within that space (Hancher and Moran 1989; 1998). Power relations are inherently embedded in, performed by and expressed in regulatory instruments. Power mobilization

and deployment is an important dynamic and inherent feature of regulation (Ioris 2015; Hurlbert 2018b; Levi-Faur 2017), with power being the ability to achieve goals in spite of opposition from others (Egan and Chorbajian 2005). The institutional analysis therefore includes a range of state and non-state institutions and instruments whose ideologies, norms and values have shaped the regulatory space of ecological restoration. This approach allows for a more dynamic examination of regulatory activities than do more rigid legal and political analyses, and recognizes that formal and informal regulation exists in a fluid, contested and potentially symbiotic relationship (Lucio and MacKenzie 2004; Vibert 2014; MacKenzie and Lucio 2014).

Multi-level institutional analysis

To identify the influence of institutions on ecological recovery and identity the regulatory drivers for restoration, this paper is primarily guided by a multi-level institutional analysis of the three regulatory case studies: MR&C in Queensland; forest restoration in Tasmania; and landscape restoration across Australia. These case studies were selected as representing different regulatory approaches to restoration with differing recovery objectives.

The multi-level institutional analysis is informed by the work of Young (2002; 2010), Gupta et al. (2013), and particularly, Hurlbert (2018), but has been adapted to focus on the regulatory elements of recovery. The multi-level institutional analysis includes identification of institutions and instruments, and analysis of drivers of recovery and the regulatory effects in achieving socio-ecological recovery following the standard set out by the Society for Ecological Restoration (SER)(Gann et al. 2019). This limits the scope of Hurlbert's (2018b)

model in that it does not consider policy effects on livelihoods or proposed redesign. Policy effects on livelihoods is beyond the scope of this research; proposed redesign will be considered in a later paper. This paper focuses on developing an explanatory account of the institutional and regulatory space of ecological restoration.

This first step of the institutional analysis involves the identification of the current institutional landscape (organizations, the regulatory framework and policy) that addresses socio-ecological recovery at national, state and local levels across the three case study sites. This part of the analysis requires some consideration of which formal and informal institutions should be selected. As the focus is regulatory, institutions that have an identified regulatory role were selected, along with key non-governmental and private organizations that have an impact upon the regulatory space.

Following institutional analysis, the second step involves identifying the predominant regulatory instruments for each case study that respond to socio-ecological degradation and support socio-ecological recovery. While instruments can be classified as regulatory, economic or market based, voluntary or managerial (Gupta, ven der Grijp, and Kuik 2013; Hurlbert 2018b), this analysis focuses on regulatory instruments; that is, instruments developed by governments or institutions pursuant to their legislative function in order to effect certain outcomes (Baldwin, Scott, and Hood 1998; Baldwin, Cave, and Lodge 2011) .

The third step in the multi-level institutional analysis considers the drivers of regulatory instruments that govern socio-ecological recovery. Drivers in this context either have a causative effect on regulatory instruments or are a driving force (Gupta, ven der Grijp, and Kuik 2013; Hurlbert 2018b) that may be direct or indirect and at various scales, including

global, national or local level (Gupta, ven der Grijp, and Kuik 2013). Drivers can also be economic, social, demographic, environmental or technological (Hurlbert 2018b).

The fourth step of the multi-level institutional analysis requires a determination of the effectiveness of the overall institutional framework in achieving social-ecological recovery. Assessing the success of ecological restoration and recovery is recognized as difficult to determine conclusively. Despite extensive discussion of appropriate metrics for assessing the success of ecological restoration (Prach et al. 2019; Evangelista de Oliveira et al. 2021), assessment is often hindered by the lack of monitoring (Wortley, Hero, and Howes 2013) and long-term goal-setting (Méndez-Toribio, Martínez-Garza, and Ceccon 2021). It is, therefore, very difficult to determine conclusively what impact the institutional arrangements are having upon ecological restoration outcomes, as this is an inherently complex question with complex answers. The independent assessment of recovery using social and ecological indicators is also beyond the scope of this study. This evaluation is guided primarily by the participants and their situated knowledge of the three case studies. Interview participants were asked whether the current regulatory arrangements for ecological restoration are achieving recovery or 'working', as well as what regulatory redesign they would undertake if they had the ability to do so. In order to further validate participant responses, the evaluation is buttressed by a comprehensive literature review and evaluation of the three previous steps of the institutional analysis. This means that effectiveness is considered in the context of the drivers that influence the regulatory space for ecological restoration, as well as the informal and formal institutional practices and independent actions of stakeholders (Hurlbert 2018b). Effectiveness is also considered in light of an institution's responsibilities and agency in relation to regulating ecological

restoration. This is because the recovery of social-ecological systems might be outside the scope of an institution's responsibilities or might be poorly effected, as a result of an institution's capacity. Fundamentally, however, this step involves the normative judgement of the researcher. Ultimately, the regulatory space of each institution is assessed as 'effective' (if indicated by an overall majority of the interviewees and the literature), 'moderately effective' (if there is some indication of effectiveness), 'ineffective' (if sources demonstrate that the regulatory framework is not achieving socio-ecological recovery) or 'unclear' (if insufficient information is available to assess effectiveness).

The multi-level institutional analysis is supported by a thorough review of relevant pre-existing literature, as well as participant interviews. Personnel associated with the three case study sites were approached to participate in the research, resulting in 37 semi-structured interviews. Of these, 34 interviews were then transcribed verbatim and coded in NVivo 12 software, using emergent and pre-assumed codes, in line with the adaptive theory model, to inform the institutional analysis. Through the process of purposive and snowball sampling, there was an attempt to ensure representation from participants across three areas: (i) strategic planners of ecological restoration; (ii) policy and regulatory experts; and (iii) implementation practitioners involved with the on-ground implementation of ecological restoration initiatives.

Limits of the research

In determining the drivers and effectiveness of the regulatory space on social-ecological recovery, the perceptions of research participants are relied upon, along with supporting

research. The views of the participants and the analysis conducted by the researcher are, therefore, inherently subjective. Interview participants were not a representative sample of society and were not gender or culturally diverse. Participants were largely well-educated and in management positions or other senior roles. Quantitative analysis of participants' social and economic status was not conducted, as demographic information was not collected. Due to ethical considerations and the Covid-19 pandemic, Indigenous community members were not included in this research and input from local non-Indigenous community members was very limited. Perspectives of local communities are, therefore, largely presented using secondary sources, from the literature or from participants who work with local communities. This lack of participant diversity is a limitation of the research in that some perspectives and knowledge(s) are missing from this analysis. In addition, the research presents a qualitative assessment of the regulatory instruments, rather than a quantitative analysis of the social, economic and ecological effects of the regulatory instruments. Despite the limitations of the research method, it is hoped that the data collected and the method allows for robust findings.

Findings

Case Study 1: Mine rehabilitation and closure (MR&C)

Institutions and instruments

In Australia, mining is largely regulated at state or territory level. The jurisdictional focus of this case study is Queensland, one of Australia's largest resource states (Mills 2022). In Queensland, the Department of Resources (DR) is responsible for mine licensing compliance,

land access and abandoned mines, with mining authorized under the *Mineral Resources Act 1989* (Qld). The Department of Environment and Science (DES) is responsible for the environmental management of operating mines and overseeing site rehabilitation. Under the *Environmental Protection Act 1994* (Qld), rehabilitation of mine sites is required to reduce disturbance caused by authorized mining activities and to minimize potential future environmental harm. Mining proponents are required to apply for an environmental authority to conduct mine activities;[29] this application must detail the proposed rehabilitation of the site with a Progressive Rehabilitation and Closure Plan (PRCP).[30] This PRCP is informed by the Mined Land Rehabilitation Policy, which requires the PRCP to identify a post-mining land use that is consistent with community consultation and local government, state or Commonwealth planning and that considers a post-extractive landscape to be rehabilitated 'when it can be demonstrated it is safe, stable, does not cause environmental harm, and is able to sustain the post-mining land use approved in the PRCP (Department of Environment and Heritage Protection, Department of Natural Resources and Mines, and Queensland Treasury, n.d., 1). Rehabilitation can be native ecosystem, agriculture, forestry, or industrial post-mine land uses. The DES assesses the PRCP and rehabilitation for a part or the whole of a surrendered mining project and will sign off on mine closure certificates.[31] In addition, the *Strong and Sustainable Resource Communities Act 2017* (Qld) requires mine operators to undertake a Social Impact Assessment to ensure that communities located near mines benefit from extractive projects and ongoing engagement is detailed. This is overseen by the Department of State Development, Infrastructure, Local

[29] *Environmental Protection Act 1994* (Qld) s. 125(1).
[30] Introduced via the *Mineral and Energy Resources (Financial Provisioning) Act 2018* (Qld).
[31] *Environmental Protection Act 1994* (Qld) ss. 318Z, 264.

Government and Planning. Ongoing concern regarding MR&C and state liability can be seen in the recent appointment of the Queensland Rehabilitation Commissioner, an independent statutory position to assist in developing best practice mine rehabilitation management.[32]

In addition to industry that is subject to the regulatory instruments identified above and whose practices and involvement in the regulatory space have shaped these regulatory arrangements, key institutions in the regulatory space include local communities, research bodies and industry bodies. Under the *Strong and Sustainable Resource Communities Act 2017* (Qld), local communities can be stakeholders in the MR&C process. Several research bodies in Queensland focus on MR&C and have had an impact on the regulatory space with research that assesses current practice, develops new technologies and best practice approaches. Industry bodies and market accreditation bodies also engage in the space by developing best practice guidelines, establishing accreditation schemes and markets, and keeping mine operators informed of technological advances in MR&C, as well as risks to social licence.

Drivers

The predominant driver for state agencies in relation to MR&C is the risk poor MR&C poses to state liability (Environment and Communications References Committee 2019; Queensland Treasury Corporation 2017; Queensland Audit Office 2013). Significant efforts have been made to limit the financial, social and environmental risk of MR&C, including significant reforms to financial assurance requirements, introducing PRCPs, requiring social

[32] Appointed under the *Environmental Protection Act 1994* (Qld) Chapter 8A.

impact assessments and establishing the Office of the Queensland Mine Rehabilitation Commissioner. The other driver for government agencies lies in facilitating mining activities. The Department of Resources frames mining as an economically beneficial activity, which contributes to the state's finances and provides significant employment opportunities. Ensuring that there is appropriate MR&C contributes to maintaining the social licence of mining operations.

For industry, drivers in the MR&C regulatory space are largely oriented towards continuing extraction and limiting restrictions in MR&C, but only to the extent that the limitations do not affect their social licence to operate. For local communities, by contrast, there are diverse drivers for MR&C. Ensuring that post-mine land is suitable for an appropriate land use is a key driver, as is ensuring benefit-sharing (including employment) throughout the MR&C process (Annandale, Meadows, and Erskine 2021; Barnes, Holcombe, and Parmenter 2020; Meadows et al. 2020). There are, however, limited options for local community engagement in the MR&C process, with social engagement and participation usually found at the front-end of mining projects (Bainton and Holcombe 2018; The Department of State Development, Manufacturing, Infrastructure and Planning 2018; O'Faircheallaigh and Lawrence 2019; Vivoda, Kemp, and Owen 2019). Efforts are being made to advocate for increased local community engagement in MR&C.

Drivers for research institutions are diverse and might include undertaking research to support the technological capacity of MR&C (see for example Doley, Audet, and Mulligan 2012; Gupta, Pant, and Corder 2022; Nguyen et al. 2022), develop MR&C accountability measures and audit MR&C regulation and practice (Vivoda, Kemp, and Owen 2019; Bainton and Holcombe 2018; Campbell et al. 2017) and engage the knowledge and voices of local

communities in MR&C (Butler, Toh, and Wagambie 2012; Annandale, Meadows, and Erskine 2021; Meadows, Annandale, and Ota 2019; Meadows et al. 2020).

For mine accreditation and industry bodies, drivers are largely tied to social licence concerns, ensuring access to markets and developing new markets.

Effect on recovery

In determining the institutional effect on social and ecological recovery, the departmental institutions were assessed as being 'ineffective'. This was due largely to participants noting issues with the regulators' capacity to enforce the regulatory framework. Some participants noted that regulators did not have the expertise or resources to ensure that mine closure is undertaken in a way that results in quality restoration. Participants also expressed concerned that this under-resourcing was leading to regulatory capture. Numerous reports on MR&C regulatory frameworks note similar deficits (Queensland Treasury Corporation 2017; Queensland Audit Office 2013), with Campbell et al. (2017, 2) noting that, 'Mine closure, complete rehabilitation and relinquishment of the former mine site is almost unknown' in the Australian context. Significant reform of the regulatory framework has recently been undertaken; however, given mining's long lifecycle, participants observed that determining whether this reform has been effective would be premature. Benefit-sharing is another ongoing issue in MR&C regulation; however, insufficient information from the literature and interview data was available to assess the effectiveness of the recent reforms regarding social impact assessments and oversight by the Department of State Development, Infrastructure, Local Government and Planning.

The Office of the Queensland Mine Rehabilitation Commissioner's effectiveness was assessed as 'unclear', due to its being a relatively recent initiative. Industry was identified as being 'ineffective' to 'moderately effective', due to practices and approaches to MR&C. Common MR&C practices identified by participants and the literature have resulted in the deferral and divestment of MR&C liabilities. For example, following active extraction, mining companies might place mine sites into 'care and maintenance' with minimal investment in rehabilitation, thereby deferring mine closure (Vivoda et al., 2019). Mining companies might also divest mines reaching the end of their productive life to lower-capitalized companies. These purchasing companies often declare insolvency when faced with MR&C liability (Owen and Kemp 2018). Mine sites also occasionally close prematurely or in an unplanned fashion, increasing the likelihood of MR&C failure (Laurence 2006). However, some larger companies were identified by participants as leading MR&C best practice.

The institutions of local communities, research bodies and industry and market certification organizations were all assessed as 'moderately effective'. Local communities are most at risk from poor MR&C outcomes (O'Faircheallaigh and Lawrence 2019); many local and Indigenous communities within the Queensland (and worldwide) have made significant strides in making their concerns heard, and increasing the accountability for mine operators undertaking MR&C (Annandale, Meadows, and Erskine 2021; Meadows, Annandale, and Ota 2019; O'Faircheallaigh and Corbett 2005). Significant barriers remain, however, to local communities engaging in the regulatory space for MR&C, including resource and capacity constraints and limited opportunities for involvement. Research bodies were assessed as 'moderately effective'. Research can provide significant independent evaluation of MR&C and its regulation, and there are strong links and relationships between research bodies,

industry and government regulators within the MR&C space in Queensland. However, research bodies can also struggle to communicate research into policy, often face funding constraints, and can be reliant on industry funding, which may direct research efforts. Industry bodies and sustainability standards and market certification schemes were assessed as 'moderately effective'. Industry bodies have been developing best practice MR&C policy and guidelines for decades, given concerns about mining's social licence (Australian and New Zealand Minerals and Energy Council and Minerals Council of Australia 2000); however, the effectiveness of this non-binding policy has been mixed. More recently, sustainability standards and market accreditation schemes have emerged as key players effecting MR&C standards and social and ecological recovery (Meadows, Annandale, and Ota 2019). Initial indications suggest that these non-government bodies and accreditation schemes may improve MR&C, as other market accreditation schemes, such as the Forest Stewardship Council, have in relation to forest restoration (discussed below; see also Schofield 2017).

Case Study 2: Forest restoration

Institutions and instruments

The forest regulatory system in Tasmania aims to ensure the partial or full recovery of native ecosystems following harvesting. The Tasmanian forest management system is facilitated by the Tasmanian Regional Forest Agreement (RFA), first signed in 1997, a long-term bilateral agreement and framework document between the Tasmanian and Australian Governments. The aim of the Tasmanian RFA is to ensure ecologically sustainable forest management across all tenure types in Tasmania, provide for the conservation of the environment and

heritage values through the establishment and maintenance of a comprehensive, adequate and representative (CAR) reserve system, and ensure certainty of resource access for the forestry industry. The agreement also largely exempts forestry operations from the federal *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act).[33] The RFA is supported by the *Forest Practices Act 1985* (Tas), which has as its objective to 'achieve sustainable management of Crown and private forests with due care for the environment and taking into account social, economic and environmental outcomes'.[34] The Department of State Growth and the Department of Natural Resources and Environment develop higher-level policy and regulation regarding the forest industry, with the Forest Practices Code (FPC) and site-specific forest practices plans (FPPs) overseen and developed by the independent regulator, the Forest Practices Authority (FPA).

It is under the FPC and the FPPs that the detail regarding reforestation or restoration is primarily regulated. While restoration was not mandatory until 2020, the FPC now requires that FPPs set out rehabilitation and restocking with the sowing or planting of species similar to those of the natural canopy for the site, using seed of local or similar provenance. Regeneration should restore the forest to its productive capacity and ecological condition, so that it contributes to future wood supply and ecosystem services.

Other institutions in the forest restoration regulatory space include Sustainable Timber Tasmania (STT), a government business enterprise which manages public production forest in Tasmania[35] under the *Forest Management Act 1985* (Tas)*, Forest Management Act 2013*

[33] EPBC Act s 38.
[34] *Forest Practices Act 1985* (Tas) schedule 7.
[35] Public production forests are classified as 'permanent timber production zone land' under Tasmania's forest management system .

(Tas), the *Forest Agreement Act 2013* (Tas) and *Forestry (Rebuilding the Forest Industry) Act 2014* (Tas). The STT is also tasked with ensuring the availability of an annual legislated wood supply volume.[36]

Industry has also had a significant impact upon the regulatory space for forest restoration, with their practices often leading to regulatory reform. Industry is regulated by the various forest regulations, particularly the FPC. Environmental non-governmental organizations (eNGOs) have similarly influenced the regulatory space for forest restoration due to advocacy which resulted in the Tasmanian Forest Agreement and *Tasmanian Forest Agreement Act 2013.* Under these instruments, changes to the permanent forest estate were made with a significant increase to the reserve estate.

Drivers

The restoration drivers for the Department of State Growth, the Department of Natural Resources and Environment, and the FPA are largely related to the triple bottom line objective, as set out in the *Forest Practices Act 1985.* Interview participants identified drivers, such as ensuring ongoing timber production for economic growth and development, as well as the management of biodiversity, particularly threatened species, in forest restoration. Participants noted, however, that the social elements of forest restoration are still emerging.

The drivers for STT include meeting the annual legislated wood supply volume and managing public production forest in accordance with their regulatory requirements. The STT's focus for restoration is predominantly on ensuring future production. The regulatory

[36] At the time of writing, this was 137,000 m^3 of high-quality sawlog: *Forest Agreement Act 2013* (Tas) s 6.

drivers for industry in relation to forest restoration lie in meeting the standards as set out in FPPs, but also in meeting any market certification requirements under programs such as Forest Stewardship Council or Australian Forestry Standard (Responsible Wood). These market certification programs have significantly influenced forest restoration in Tasmania, especially in the absence of clear regulatory requirements (Schofield 2017).

The drivers for eNGOs in Tasmania in relation to the regulatory space for forest restoration are largely related to advocacy on conservation. Most eNGOs within Tasmania seek an end to native forest harvesting and a higher standard for forestry restoration in the FPC. A small number of eNGOs are also undertaking forest restoration, with the drivers for these eNGOs largely tied to funding. Forest restoration by eNGOs could also be impeded by the regulatory system, with restoration of former plantations or any planting of native forests requiring an FPP. The cost of this permit was recently waived for eNGOs.

Effect on recovery

State departments were assessed as being 'moderately effective' in relation to recovery. This is due to the influence of politics on their operations. Participants noted that government agencies were bound to follow the political agenda of the current government. The triple bottom line approach set out in the *Forest Practices Act* results in various departments having different responsibilities for the management of Tasmania's forests. The Tasmanian forestry system has been, and continues to be, a highly politicized and contested space, with governments taking different approaches to forest restoration over the years. As participants pointed out, the regulatory drivers for forest restoration have largely come from

market certification programs and changes to industry practice, rather than from changes to government policy.

The FPA is also required to meet social, economic and environmental objectives under the triple bottom line approach, but due to its independence and a long-term, adaptive management approach with a commitment to the ethos of forestry, the FPA was assessed as 'moderately effective' to 'effective'. Effectiveness is hampered somewhat by oversight following forest harvesting being limited to approximately five years and its limited, but emerging, focus on the social aspects of recovery.

The STT was assessed as being 'moderately effective'. The STT management of the public estate for recovery has been hindered by the minimum legislated wood volume, which results in a risk of homogenous forests. The STT is, however, undertaking landscape-scale management and has improved restoration processes to enhance environmental and threatened species outcomes. Similar approaches are being undertaken by industry with certification programs and oversight by the FPA, resulting in a forest industry that is 'moderately effective' in achieving recovery.

ENGOs were assessed as 'moderately effective' to 'effective', due to their advocacy and restoration practices. The effectiveness of eNGOs with respect to recovery is hampered by funding, personnel and resource capacity.

Case Study 3: Landscape restoration across Australia

Institutions and instruments

Landscape restoration has been defined simply as restoration that 'includes large, contiguous, or fragmented areas (equal to or greater than several km^2)' (Menz, Dixon, and Hobbs 2013, 526). Generally, landscape-scale restoration is undertaken voluntarily, often by large landowners or non-governmental organizations (NGOs), such as Landcare,[37] The Nature Conservancy,[38] Greening Australia[39] or regional Natural Resource Management (NRM) groups.[40] These organizations might be assisted or guided by research institutions.

The regulatory space for non-mandatory/voluntary restoration is quite limited. There is, however, some federal, state and local government involvement. If the restoration in question might have an impact on matters of national environmental significance (MNES), proponents are subject to the regulatory processes under the EPBC Act and EPBC Regulations. On public land managed by government authorities, proponents need to navigate the state regulatory requirements of those natural resource bodies which manage the public land; on private land, restoration can be undertaken with the permission or at the instigation of the landholder. State governments also manage conservation covenant schemes across Australia, which are often sought in relation to restoration on private land. In Tasmania, restoration activities on private land may be subject to regulation by the Forest

[37] Landcare Australia, 'What do people involved in Landcare do?' (webpage: landcareaustralia.org.au/about/what-do-people-involved-in-landcare-do/ accessed 23 December 2022).
[38] The Nature Conservancy Australia, Reef Builder: Rebuilding Australia's lost shellfish reefs' (webpage: www.natureaustralia.org.au/what-we-do/our-priorities/oceans/ocean-stories/restoring-shellfish-reefs/ accessed 23 December 2022).
[39] Greening Australia, 'Our programs' (webpage: www.greeningaustralia.org.au/our-programs/ accessed 23 December 2022).
[40] Department of Climate Change, Energy, the Environment and Water, 'Regional Organisations' (webpage: www.dcceew.gov.au/environment/land/landcare/current-programs/regional-organisations accessed 23 December 2022).

Management System, if the restoration activities involve reforestation. In such cases, a FPP is required. Restoration projects might also be subject to local planning laws and requirements.

In the absence of formal regulatory standards, proponents are free to adopt any set of standards; for example, some adopt the SER international standards as the leading standards for restoration in Australia, while others seek to meet the standards established in their funding arrangements. Standards are varied, with definitions of restoration ranging from monoculture tree plantings to recovery in line with surrounding or former ecosystems.

Other institutions that affect the regulatory space for landscape restoration include industry and philanthropic funding bodies, which often fund restoration projects. Such bodies are bound by income tax assessment rules and conservation covenant and carbon market regulation, where these are applicable to their operations.

Drivers

For the federal and state governments, drivers relate to their responsibilities in the management of natural resources and the conservation of threatened species and biodiversity. While the regulatory environment differs across jurisdictions, both federal and state government bodies are significant funders of environmental management and have established a range of funding programs for environmental management programs. At the federal level, this includes the National Landcare Program, the National Heritage Trust, Caring for Country, the Environmental Stewardship Program, the Green Army, the Environmental Restoration Fund and the Threatened Species Recovery Fund. At the state

level, a range of similar programs receive funding, the majority of which is delivered through one-off, project-by-project financial grants.

The drivers for local government differ from those of federal and state governments. While landscape restoration does not necessarily fall within the purview of local government, these institutions can provide small amounts in funding and provide access to land and local government reserves for Landcare programs, as well as spaces for restoration community groups to meet. Local planning schemes can hinder restoration efforts, particularly in relation to the development of local areas, which can impact ecological corridors and local biodiversity. Development of land is a significant diver for local governments.

For NGO, Landcare and regional NRM groups, the primary driver to engage in the restoration regulatory space is funding. In undertaking restoration, these groups are primarily funded by federal and state institutions through one-off, project-by-project grants. There is an estimated annual shortfall of AUD 10 billion in restoration funding across Australia (Ward and Lassen 2018). Additionally, landscape restoration can be facilitated or hindered by access to land, particularly where projects seek to increase ecosystem connectivity, with many restoration projects undertaken partly or wholly on private land (Collard et al. 2020). Interview participants noted that, with a focus on relationship and trust building, as well as community engagement and participation and appropriate incentives, this barrier of access to private land could be overcome.

For research bodies engaged in landscape restoration research, drivers include conducting research to support the technological, social and ecological capacity of landscape restoration, and developing best practice restoration guidelines, such as the SER international and

national standards (Gann et al. 2019; McDonald, Jonson, and Dixon 2016). Research organizations can also become involved in on-ground project development and undertake monitoring and evaluation. Research organizations may also be interested in engaging and amplifying the knowledge and voices of local communities. The availability of funding for research institutions was identified by interview participants as a key determinant for research institution engagement in the regulatory space, along with the development of community and industry linkages.

In response to the annual shortfall in public funding, the *Samuel Report* (2020) found that co-investment (that is, both public and private funding in restoration) is required to enhance biodiversity conservation and public expenditure (see also Iftekhar et al. 2017; Collard et al. 2020). The report notes the potential for private capital investment, with the responsible investment market in 2018 equating to AUD 980 billion and sustainability-themed investment equating to AUD 70 billion (RIAA 2019)—an amount that is only likely to increase (Samuel 2020). Participants in this case study identified the potential of private investment; many noted efforts to seek private investment. As identified by Collard et al. (2020) and interview participants, private funding is likely to lead to the prioritization of projects with private economic benefits, such as carbon credits, biodiversity offsets or payments for ecosystem services. Private funding bodies are also often interested in ensuring conservation covenants over the restoration projects they fund. Collard et al. (2020) and the *Samuel Report* (2020) both note that greater alignment between private and public investment and priorities is needed.

Private landholders are the final institution considered in the regulatory space for landscape restoration. As mentioned above, restoration is often undertaken on land held privately

(Collard et al. 2020), with private landholders, including farmers and Indigenous traditional owners, managing 77% of Australia's land mass (Ward and Lassen 2018). Regulatory drivers for their involvement include access to markets (such as carbon credits or other such payments) or funding through conservation initiatives (such as conservation covenants or stewardship payments). Interview participants from the agricultural sector also noted that landscape restoration develops shade and shelter and could cover the costs of fencing, as well as market access. They also noted that restoration activities often result in a higher market price or market access, where sustainability certification is available as a result of the activities.

Effect on recovery

As noted above, funding for landscape restoration is largely delivered through one-off, project-by-project grants. The *Samuel Report* (2020) into the EPBC Act found that, while these programs may have achieved their objectives (it was, however, difficult to discern the specific effect of investment on outcomes), they have not prevented ongoing environmental decline and are largely inadequate for environmental protection and conservation (see also Richardson and Davidson 2021; Collard et al. 2020; Saunders et al. 2022). The report also identifies a lack of coordination in achieving biodiversity benefits between various programs and no clear plan in the prioritization of investment for protection, conservation and restoration across Australia (Samuel 2020). Interview participants reiterated these concerns. Rarely allocated for more than three to four years at a time, funding for landscape restoration does not usually allow for ongoing monitoring and management, thereby significantly curtailing land managers' ability to assist in the recovery of degraded

landscapes. Monitoring is a key element in the success or failure of restoration (Lindenmayer et al. 2018). Short funding periods mean that funding focuses on operations and that limited funding is available for institutional and administrative capacity, thereby resulting in high personnel turnover, loss of place-specific knowledge, and limited relationship and trust building between project and communities.

For these reasons, state and federal governments were assessed as being 'ineffective' to 'moderately effective' in regulating for social-ecological recovery. Local government was assessed as having similar effectiveness due to limitations often found in local planning schemes and a focus on development, rather than social-ecological recovery.

Due to imaginative approaches and the commitment of personnel, NGO, Landcare and regional NRM groups were assessed as being 'moderately effective' to 'effective'. The outcomes from restoration projects led by these groups varied, however, due to the constraints outlined above.

Private funding bodies and private landholders were also assessed as 'moderately effective' to 'effective'. Private funders and landholders are often aligned with investment in carbon markets, which has the potential to result in monocultures. Private investment and restoration are also often poorly coordinated; however, there have been significant efforts to address this. From a positive perspective, private funders and landholders contribute significantly to landscape restoration across Australia, often when governments do not.

Institutions	**Key regulation**	**Responsibilities**	**Drivers**	**Effect on recovery**
CASE STUDY 1: MINE REHABILITATION AND CLOSURE				
Federal government	*Environment Protection and Biodiversity Conservation Act*	Overseeing the operation of the EPBC Act and the *Native*	Management of matters of national environmental significance; Ensuring a	Ineffective

	1999 (Cth) (EPBC Act); *Native Title Act 1993* (Cth)	*Title Act*; Developing best practice guidelines for MR&C	robust mining industry as contributor to GDP; Limiting state liability for MR&C	
State governmental departments	*Mineral Resources Act 1989; Environmental Protection Act 1994; Strong and Sustainable Resource Communities Act 2017; Mineral and Energy Resources (Financial Provisioning) Act 2018;* Mined Land Rehabilitation Policy	Planning, monitoring, implementation and review of mineral resource regulation; Issue environmental authorities; Responds to non-compliance; Issue mine closure certificates; Develop guidelines and policy on social impact.	Limiting state liability and responsibility for MR&C; Facilitate a robust mining industry which contributes to the state's budget and employment; Ensure social licence for mining remains current.	Ineffective to moderately effective
Office of the Queensland Mine Rehabilitation Commissioner	Appointed under *Environmental Protection Act 1994* Chapter 8A	Produce technical reports on trends and best practice MR&C; Provide advice to the Minister on MR&C practices, outcomes and policies.	Undertake review of MR&C practices and report to government; Limit state liability for MR&C.	Unclear
Industry	Subject to the *Mineral Resources Act 1989; Environmental Protection Act 1994; Strong and Sustainable Resource Communities Act 2017; Mineral and Energy Resources (Financial Provisioning) Act 2018;* Mined Land Rehabilitation Policy	Meet their responsibilities under the relevant regulation; Meet their responsibilities to shareholders where relevant.	Ensure ongoing access to resources; Lower production costs where relevant; Maintain social licence.	Ineffective
Local communities	*Strong and Sustainable Resource Communities Act 2017; Native Title Act 1993* (Cth).	Stakeholders in MR&C. May be the final landholders under Native Title.	Ensure MR&C is undertaken to allow for post-mine land use; advocate for benefit sharing in MR&C.	Moderately effective
Industry and market certification bodies.	Sustainability standards and certification programs	Develop best practice guidelines for MR&C and disseminate; advocate on behalf of industry	Maintain social licence to operate; develop best practice for MR&C;	Ineffective to moderately effective
CASE STUDY 2: FORESTRY RESTORATION				
State governmental departments	*Forestry (Rebuilding the Forest Industry) Act 2014*; *Threatened Species Protection Act 1995; National Parks and Reserves Management Act 2002;* Permanent Native Forest Estate Policy; Tasmanian Regional Forest Agreement (RFA).	Policy development for forest industry; monitoring, implementation and review of the RFA; collect information and manage natural and cultural values; manage formal reserves, Crown land, and 'Future Potential Production Forest' land.	Ensure ongoing timber production and industry growth; uphold the RFA; manage natural and cultural values; manage and undertake restoration on Crown land, reserves and Future Potential Production Forest.	Moderately effective
Forest Practices Authority	*Forest Practices Act 1985;* Forest Practices Regulations 2017; Forest Practices Code	Implementing and regulate the forest practices system by publishing the Forest Practices Code, issue and monitor Forest Practice Plans.	Oversee the forest practices system including restoration.	Moderately effective to effective
Sustainable Timber Tasmania	*Forest Management Act 1985; 2013; Forestry (Rebuilding the Forest Industry) Act 2014.*	Manage the Permanent Timber Production zone land by planning and monitoring to ensure a sustained wood	Ensure a sustained wood yield to meet minimum legislated supply.	Moderately effective

		yield; Sustainably manage non-wood values.		
Industry	*Tasmanian Forest Agreement Act 2013; Forestry (Rebuilding the Forest Industry) Act 2014*	Undertake reforestation in line with Forest Practice Plans.	Maintain social licence; Meet accreditation requirements for market-based certification programs.	Moderately effective
eNGOs	*Tasmanian Forest Agreement Act 2013*	Stakeholder in forest industry discussions.	Advocate for conservation outcomes and increased restoration standards; undertake restoration.	Moderately effective to effective
CASE STUDY 3: LANDSCAPE RESTORATION				
Federal government	*Environment Protection and Biodiversity Conservation Act 1999; Carbon Credits (Carbon Farming Initiative) Act 2011; Natural Resources Management (Financial Assistance) Act 1992*; National Landcare Program; Commonwealth Grants *Rules* and Guidelines 2017; Australia's Strategy for Nature 2019-2030; Environmental Restoration Fund.	Manage matters of national environmental significance; Oversee the development and regulation of the national carbon credit market; Provide funding for NRM; oversee the National Reserve System.	Oversee the development and regulation of the national carbon credit market and a national nature repair market; meet community expectations for conservation; limit state liability for land degradation.	Ineffective to effective
State government	Regulation for land use planning; management of conservation covenants; regulation of environmental and biodiversity offsets; Regulation for the management of formal reserves and Crown land.	Manage formal reserves and Crown land; oversee land use planning and set planning policies; manage conservation covenants and environmental and biodiversity offset schemes; undertake rehabilitation of degraded Crown land; establish funding for NRM.	Facilitate (sustainable) land development; limit state liability for land degradation; meet community expectations for conservation.	Ineffective to effective
Local government	Local planning laws	Oversee local planning and development; Manage local reserves	Facilitate local land development; meet community expectations for local reserve management.	Ineffective to moderately effective
NGO, Landcare, NRM groups	*Charities Act 2013* (Cth); *National Landcare Program Natural Resources Management (Financial Assistance) Act 1992* (Cth).	Meet requirements under relevant regulation; undertake restoration activities in line with funding arrangements and organizational mandate.	Funding; Access to private property; community engagement and participation.	Moderately effective to effective
Private funders, landholders	Conservation Covenants – each state and territory has approved covenanting programs by the Environment Minister for the purposes of the *Income Tax Assessment Act 1997.*	Meet tax and property requirements under relevant regulation.	Philanthropy and personal interest in restoration; carbon and biodiversity credits; maintaining social licence; shade and shelter for agricultural landholders.	Moderately effective to effective

Table 4: Summary of the multi-level institutional analysis

Discussion

In this section, I explore the impacts and consequences of current institutions managing ecological restoration and recovery across scales. First, I look at state institutions and their role in regulating land degradation and ecological restoration. Second, I address the positive feedback mechanism through which regulation for ecological restoration ends up legitimating land degradation. Third, I outline how a range of institutions in the regulatory space for ecological restoration and recovery see ecological restoration as an effective tool in limiting state liabilities. Fourth, I show that many of the drivers of ecological restoration regulation are market based, as the state seeks to monetize ecological restoration.

State institutions regulate land degradation and restoration

Ecological restoration has emerged as a response to environmental decline and the social and ecological consequences of post-extraction landscapes and degraded ecosystems (Samuel 2020; Trigger 1997). Prevalent amongst the extractive industries, such as mining and forestry, are assumptions that such activities are 'renewable' (Department of State Growth 2021; Stevens and Dixon 2017; Trigger 1997); however, in line with sustainable development principles, entities undertaking extraction should also be liable for the externalities associated with production. Regulatory bodies established to manage extraction have become responsible for the regulation of restoration following extraction. Ecological restoration generally falls within the same regulatory framework as infrastructure development or extraction. Regulation of environmental interests therefore aims to balance economic development, while simultaneously seeking to protect a state's

citizens from the negative impacts of economic development (Vivoda et al., 2019), with restoration often falling within the same regulatory framework as infrastructure development or extraction.

My institutional analysis of the responsibilities of institutions involved in regulating restoration demonstrates that this dual function of regulatory bodies exists in relation to the two mandatory restoration case studies—Case Study 1: MR&C in Queensland and Case Study 2: Forest restoration in Tasmania. The Queensland DR and the DES (in Case Study 1) and the Tasmanian FPA (in Case Study 2) are tasked with regulating and articulating the value of land degradation, as well as setting the regulating standards for restoration. According to Vivoda et al. (2019, 411), this tension between the 'enabling' and 'restricting' elements of regulatory frameworks (in relation to MR&C) requires an 'appropriate balance'. Vivoda et al. (2019) identify an imbalance in MR&C, with enabling regulation overemphasized in the early stages and restrictive regulation underemphasized in the later stages as mines reach closure. Drawing on the work of Jeremy Bentham (1789), they argue that getting this balance right is 'the art of government' (Vivoda, Kemp, and Owen 2019, 411); however, an 'appropriate balance' is not clearly articulated. What is or is not appropriate will necessarily be determined by the underlying values and norms of the institution(s) making that determination. Reference to Bentham's (1789) 'art of government' suggests a positivistic approach to regulation (Schofield 2013; 2021), in which a unidimensional social reality is strongly linked to economic analysis and economic advancement (Posner 2001; 2011).

Questions regarding the regulation of restoration cannot be divorced from questions concerning land degradation. This means that the competing priorities of land degradation, conservation and restoration will continue to impede socio-ecological recovery. Until the

regulation of restoration addresses the underlying causes of land degradation, ecological restoration will continue to result in limited recovery and, potentially, even cause perverse outcomes (Osborne et al. 2021; Bliss and Fischer 2011; Elias, Joshi, and Meinzen-Dick 2021).

Ecological restoration seeks to legitimize land-degrading activities

Following on from the discussion above is the finding that the drivers for ecological restoration institutions involved in the regulatory space (particularly institutions that regulate land use and natural resources) are oriented towards legitimizing and continuing land-degrading activities. Land development, particularly through mineral extraction, is considered an appropriate land use in Australia. The mining industry, in particular, has made significant efforts to brand its activities in language that associates mineral extraction with 'frontier development', 'prosperity' and 'nation building', thereby equating resource extraction to bringing wealth and civilization to 'undeveloped areas' and framing it as a moral imperative (Trigger 1997). State and territory goverments across Australia have promoted and incentivized resource development with the aim of improving the economic performance of the state through employment and wealth creation. With the rise of environmentalism in the 1970s and 1980s came a growing recognition that extractive activities have serious environmental and social consequences; governments now face significant public pressure to regulate these industries. As a result, governments across the Western world have attempted to incorporate 'sustainable development' into the regulation of resource industries, such as mining and forestry, and continue to legitimize these industries through the regulation of negative environmental and social impacts (Department

of Resources 2022; Department of State Growth 2021). These regulatory arrangements assert that it is possible to 'borrow' temporarily from 'nature' and return it to a form similar to the previous ecology or to a system that will facilitate future economic use (Trigger 1997). However, restoration rarely results in an analogous ecosystem (Jones et al. 2018). Successful socio-ecological recovery can also take decades, if not centuries (Nilsson et al. 2016). This raises the question of whether land-degrading industries can really be considered temporary land users. In the MR&C case study, changes in geomorphology and ecosystem function, from what can be decades of mine operation, may result in a landscape unable to support a similar ecosystem or even a suitable post-extraction land use (Lamb, Erskine, and Fletcher 2015). Variation in mine rehabilitation can thus result in extensive 'novel' ecosystems that have limited social or ecological value (Erskine, Vickers, and Mulligan 2008). The situation differs somewhat in the forest restoration case study, where participants noted that the discipline of forest sciences has a long history in the forestry industry, which considers reforestation an essential part of forest management, but also raised ongoing concerns about the restoration of non-commercial values of the forest ecosystem.

Where land degradation has occurred and restoration is either not achieved or not legally required, non-mandatory restoration projects might be undertaken, largely funded by governments. The standards for such projects are minimal, as is oversight and accountability. This is despite quite comprehensive obligations for conservation and restoration, such as MNES (which the federal government is required to manage under the EPBC Act) or the various obligations of state governments under nature conservation and threatened species legislation (Samuel 2020; Akhtar-Khavari and Richardson 2020). State institutions operate primarily as funding bodies and discharge their obligations for

restoration of degraded landscapes in a largely ad-hoc and poorly integrated way (Samuel 2020).

Limiting state liability: the long tail of land degradation

As identified in the mandatory case studies (Case Studies 1 and 2), but particularly in relation to MR&C (Case Study 1), a primary concern of state institutions in relation to the regulation of restoration is limiting state liability. From a long history of facilitating extraction and land degradation, combined with poor regulatory oversight of restoration, state institutions now find themselves responsible for the negative social, economic and ecological consequences of extractive and land-degrading activities. In the MR&C case study, an estimated 60,000 abandoned mines exist in Australia (Unger et al. 2012). Liability for poorly rehabilitated or abandoned mines transfers to the state, so regulatory systems across Australia are attempting 'catch-up' to reduce the environmental risk and costs of mine closure sites. In Queensland, this has resulted in regulatory reform which seeks to ensure 'progressive' rehabilitation (although this is not always possible, depending on the type of mine) and that mining companies have sufficient financial capacity for mine closure (Mills 2022).

Drivers of non-mandatory restoration are market orientated

Evident in many of the participant interviews and the institutional analysis is an assumption that social ecological systems can and should be monetarily valued. This is evident in discussions about the value of restoration, the way in which restoration should be funded and appropriate drivers of restoration. Interview participants noted that regulatory systems

assess social value, and even the ecological value of ecological restoration and recovery, against the monetary value of extraction, with other non-monetary or non-commensurable values of restoration largely invisible. While participants acknowledged that this monetary valuation of social and ecological indicators is problematic, they also thought that making the social and ecological value of restoration visible through monetary evaluation is important. Boon and Prahalad (2017) explore the marketization of conservation and argue that nature conservation in Australia has come to be dominated by neoliberal ideology, with little socio-political debate within conservation biology and ecology circles. They argue that this neoliberal ideology has two key assumptions: (i) that ecosystem services can and should be monetarily quantified as the best possible allocation of the value of ecosystem services; and (ii) that establishing complementary areas to offset biodiversity loss is the most efficient way to balance nature conservation and economic development (Boon and Prahalad 2017).

Participants identified carbon markets as potential sources of income and drivers for restoration, particularly for landscape restoration. Carbon credits can already be obtained for ecological restoration under the *Carbon Credits (Carbon Farming Initiative) Act 2011* (Cth) and have been utilized to fund landscape restoration projects across Australia (Evans 2018; Evans et al. 2015; Richardson and Davidson 2021). Participants noted that carbon markets are largely incapable of valuing biodiversity, meaning that restoration is at risk of being undertaken in a singular fashion that focuses only on carbon metrics. Situating carbon as the only metric by which ecosystem services are measured can have significant implications for biodiversity. A focus on carbon credits can result in monoculture tree plantations, for example, that are cost-effective but do not effect socio-ecological recovery (Galatowitsch 2009; Veldman et al. 2015; Fleischman et al. 2020; Bremer and Farley 2010).

Participants suggested that carbon markets should be combined with biodiversity management—a combination that can result in neutral, if not positive, carbon outcomes (Hulvey et al. 2013; Standish and Prober 2020). However, significant regulatory and policy challenges exist in accounting, carbon counting and carbon pricing (Samuel 2020; Hulvey et al. 2013; Standish and Hulvey 2014; Mitchell, Harper, and Keenan 2012). The current Australian (federal) Government has noted these concerns and recently announced a national nature repair market to allow businesses and individuals to invest in landscape restoration (DCCEEW 2022). This national market aims to meet the shortfall in funding for ecological restoration by enhancing private investment in biodiversity; however, details of how this scheme will operate are still being developed (DCCEEW 2022, 23; Commonwealth of Australia 2022).

Biodiversity offset schemes were not particularly relevant for participants in the case studies, but participants did identify more generally that such schemes are becoming increasingly popular and problematic. Biodiversity offsets are measurable outcomes for biodiversity conservation that are intended to compensate in full for biodiversity impacts or losses associated with land clearing and economic development projects (Jellinek et al. 2019). Offsets are said to 'facilitate economic development coupled with more efficient means for funding nature conservation (as 'green growth'), especially given sharp fiscal constraints' (Boon and Prahalad 2017, 122). The number and influence of biodiversity offset programs are growing rapidly worldwide, driven by regulatory and economic requirements (Maron et al. 2012; Bull et al. 2013).[41] Biodiversity offset schemes assume that restoration

[41] A leading example in Australia is in the state of New South Wales, where the *Biodiversity Conservation Act 2016* (NSW) has established the Biodiversity Offsets Scheme.

can recreate ecosystems with equivalent biodiversity and that there is 'no net loss'. There has been significant critique in Australia (Akhtar-Khavari and Richardson 2020; Samuel 2020; Maron et al. 2015) and elsewhere regarding the operation of biodiversity offsets, with Samuel (2020) noting that the current offsets policy under the EPBC Act contributes to environmental decline, rather than restoration.

Conclusions: the environmental statehood of recovery

This institutional analysis reveals significant contradictions and paradoxes in the way state institutions approach the regulation of ecological restoration. On one hand, state institutions seek to uphold and legitimize land degradation through market creation and the regulation of natural resources. On the other, they seek to protect local communities and the broader public from the negative social and ecological consequences of these activities. M'Gonigle and Takeda (2013, 1005) call this a 'deep contradiction', in that environmental regulation is developed by the state, but the state is also the primary driver of development. To deepen the analysis of the spatial, temporal and political challenges within the regulatory space for ecological restoration and link to the local to the global frame (Layder 2021), this paper employs the socio-political concept of 'environmental statehood', as articulated by Ioris (2015).

The concept of environmental statehood explores the ways in which the state manages and contains environmental conflicts, while simultaneously asserting its sovereignty. Following a Marxist analysis of the Hegelian theory of the state, Ioris (2015, 167) argues that the state is 'more than just the administration of public matters over resources and ecosystems, but

comprises the affirmation of specific ideologies and techniques of socio-ecological organisation'. Contained within the state are institutions and regulatory instruments that comprise structures and processes that reflect the values and balance of political power. The legitimacy and sovereignty of the state is maintained by the construction and reconstruction of socio-ecological processes and practices with the 'control and management of nature ... always central to the realization and consolidation of state power' (Whitehead, Jones, and Jones 2007, 6; see also Osborne et al. 2021; McCreary and Lamb 2014; Natarajan and Khoday 2014). According to Parenti (2015, 830), the state 'does not have a relationship with nature, it is a relationship with nature'. Ioris (2015) argues that the core task of the modern state is, therefore, to naturalize and maximize anti-commons institutions and undertake the administration of the socio-ecological impacts of resource production. Regulation has a key role in this process (Levi-Faur 2017). Regulation under environmental statehood thus aims to ensure access and control of aspects of socio-ecological systems that have economic and or political relevance (Ioris 2015), with contemporary environmental policy and regulation upholding markets and resource production in line with neoliberalism.

The genesis of neoliberalism is usually associated with the policy platforms of the 1980s Thatcher and Reagan governments in the UK and US, respectively (although the term has been identified in use far earlier in Latin America (Grewal and Purdy 2014)). Policies that have come to define neoliberalism include deregulated free markets, the privatization of public assets and the shift of the state from public to private law (Blalock 2014; Boon and Prahalad 2017). Far from being a bystander, the neoliberal state, through its regulatory capacity, plays 'an active role in supporting the market and correcting market failures' (Blalock 2014, 85) with regulatory bodies promoting the commodification of capital and

labour (Levi-Faur 2017 who also suggests that capitalism itself is a regulatory institution). Blalock (2014, 83) writes that, 'The rule of law under neoliberalism is not designed to allow individuals to enact a collective vision of society; rather, it is first and foremost designed to enable individuals to plan their actions according to market logic'. It is, in that sense, a mode of reason (Brown 2017). The role of regulation, in line with neoliberal ideology, is therefore to ensure that the production of goods and services is maintained and that government actions support and prioritize market initiatives, especially through the regulation of competition (Levi-Faur 2017) and the reduction of production costs and uncertainties. The social and ecological impacts resulting from capital accumulation are considered 'externalities' (Baldwin, Cave, and Lodge 2011). Regulation aims to limit social conflict from the 'commodification, decommodification and recommodification' of social-ecological resources (Levi-Faur 2017, 293–96), but the state 'does not arbitrate conflicts, it moderates them by keeping them within the limits of the established order' (Lefebvre 2009, 84; see also McCreary and Lamb 2014). Regulatory approaches seek to address harms individually, with regulation developing in a fragmented and incremental way and ignoring cumulative and systemic problems (Parker and Haines 2018, 137). Flexible and adaptive institutions provide the political legitimacy and regulatory elasticity required for contemporary environmental policy to maintain development, with the management of social-ecological systems for social and ecological wellbeing simply considered incidental (Ioris 2015).

The elements of environmental statehood are reflected in the case studies. State institutions continue to articulate the value of extraction and land degradation, particularly in the mandatory case studies of MR&C (Case Study 1) and forest restoration (Case Study 2), with attempts to set regulatory standards designed to reduce social conflict and ensure ongoing

land-use activities. Ecological restoration is used to legitimize land-degrading activities and continue the process of state-making (Osborne et al. 2021), with the recovery of socio-ecological systems contained within the processes of the state (see DCCEEW 2022 for a recent illustrative example of this approach). The fact that many of the drivers for restoration are market-orientated is no coincidence. Markets for restoration do not emerge spontaneously as autonomous, self-regulating institutions, but are instead fostered, created and defended by the state with the support of powerful industry institutions, reflecting values and an ideology that sees markets and competition as positive (Polanyi 2001; see also Lange 2015; McGee and Steffek 2016). These markets are then adopted by non-governmental bodies, private citizens and other stakeholders. Carbon markets, for example, have developed as a result of climate change policies shifting from a focus on taxes or licensing to markets (McGee and Steffek 2016). Markets for ecological restoration also allow for the value of social and political difference to be reduced to the 'common' value of money, with restoration recognized only as a commodity (Boon and Prahalad 2017; Osborne et al. 2021). As Osborne et al. (2021, 102320) observe, this can 'oversimplify ecosystems to the essential and marketable "nature that capital can see"'—this could be agroforestry monocultures, for example—and risks ecological restoration becoming extractive. Galatowitsch (2009, 563) cautions that markets risks 'the market price … likely governing the quality of restoration, not the reverse'. The commodification of restoration also cements the recognition of natural resources as private property and the primacy of private property in the regulation of socio-ecological systems (see generally Blalock 2014; Garver 2019; Pellizzoni 2004), thus continuing a nature-culture binary in law (Grear 2011b; De Lucia 2013).

Social and ecological value is in danger of being rendered invisible when economic value is the default in the management of natural systems (Vatn 2009b). Markets can facilitate the erasure of the value of socio-ecological difference. Ecological restoration is a place-specific practice (Gann et al. 2019); by establishing markets, the value of social and ecological difference is often lost. This means that restoration might not recognize the existing biodiversity or social diversity of a particular system and will implement systems that are ill equipped to meet an existing or former system's diversity. Despite the value of difference being lost, the consequences of such interventions will continue the uneven distribution of environmental problems: temporally, spatially and politically (Ioris 2015; Osborne et al. 2021).

As identified above, restoration's regulatory timescale is limited. A market approach to restoration means that the long-term management requirements for mandatory restoration are usually no longer than 5 to 10 years, tied to market timeframes. Non-mandatory restoration projects are usually only funded for 1-4 years. Participants identified the long-term management requirements for ecological restoration as significantly inadequate. Recovery, or even a trajectory of recovery, will rarely be achieved within a decade. Long-term land managers who take on the responsibility of the relinquished land may continue restoration activities, but are usually limited by funding, resources, capacity and accountability requirements.

The reasons for the poor rates of recovery are far deeper than a lack of funding or a need for better standards. The analysis presented above demonstrates that the failures of ecological restoration are systematic and implicitly tied to the manner in which the state regulates environmental concerns. Recovery of degraded landscapes will not be achieved until we

have regulatory approaches that seek to prevent damage to landscapes and repair social and ecological wellbeing, rather than regulatory systems predicated on replacing biodiversity loss with reconstructed ecosystems (Wilkins, Keith, and Adam 2003).

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Chapter 4

The question that was apparent following Chapter 3 was what regulatory and institutional arrangements should replace, reform or transform the regulatory arrangements for ecological restoration? Chapter 4 completes the institutional analysis as initiated in Chapter 3 and responds to Research objective 5: To identify important elements for the design of regulatory frameworks that can facilitate recovery.

This chapter adopts Wright's (2010) strategic approach to transformation (ruptural, interstitial, symbiotic) as part of an institutional theory of change. This theory of change informs the identification of transformative strategies from data collected from participant interviews. Seven transformative strategies are identified and are classified as either ruptural, interstitial or symbiotic. These strategies are summarized in Table 5. Wright's (2010) typology is drawn from the history of anti-capitalist struggle. Wright (2013, 20–21) situates these strategies within certain social movements and politics: ruptural strategies within the revolutionary politics of socialism and communism; interstitial strategies within certain anarchist movements; and symbiotic strategies within social democracy politics. The strategies identified in this chapter often cross the various typologies; but they are not designed to operate in isolation. As Wright (2013, 21) notes, transformation will likely require a 'strategic orientation' around interactions between interstitial and symbiotic strategies with periodic ruptural strategies. The strategies presented in this manuscript are not, however, the only strategies suitable for transformation. A commitment to plural futures requires a diversity of responses, all negotiated in line with democratic processes and local social-ecological characteristics.

This chapter contributes to and builds on scholarship that has put forward regulatory responses that challenge dominant neoliberal regimes in the management of social-ecological systems and re-imagine regulation for social and ecological sustainability and justice (Parker and Haines 2018; Morgan 2015; de Sousa Santos and Rodríguez-Garavito 2005). Like Osborne et al. (2021), this chapter is committed to transformation within the process of ecological restoration, recognizing that the underlying orientation of current regulatory frameworks is designed around land degradation and ongoing resource development rather than the recovery of social-ecological systems and the fostering of social and ecological well-being.

Transformation strategies for the re-design of ecological restoration regulation for social-ecological recovery

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Abstract

Ecological restoration has been identified as a solution to land degradation, biodiversity loss and climate change. Although often framed as apolitical, ecological restoration cannot be understood as being outside its social, political and economic relations, as regulation is a key component to its success. A recent institutional analysis of the regulatory frameworks across three case studies in Australia demonstrates that, despite ecological restoration's potential, the regulatory arrangements for the practice are facilitating ecological decline, rather than promoting recovery. This paper completes the institutional analysis initiated in Chapter 3 to consider the re-design of regulatory frameworks for ecological restoration. By adopting Wright's (2010) typology of social transformations, this paper overcomes the dichotomy of top-down or bottom-up transformation responses prevalent within sustainability transformation and transition literature. Drawing on interviews with expert participants, it sets out seven transformative strategies for pluralist democratic futures. With ecological restoration now a global priority, these strategies are identified for their potential to address the fundamental drivers of land degradation and to contribute to socio-political transformations that place social and ecological wellbeing at their core. This paper contributes to scholarship that seeks to put forward diverse regulatory responses in order to challenge dominant neoliberal regimes and re-imagine regulation for social and ecological wellbeing and justice.

Introduction

Ecological restoration has become a prominent global solution to land degradation, biodiversity loss and climate change (Aronson and Alexander 2013; FAO, IUCN/CEM, and SER 2021; Fischer et al. 2021). Defined as the 'process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed', ecological restoration 'aims to move a degraded ecosystem to a trajectory of recovery that allows adaptation to local and global changes, as well as persistence and evolution of its component species' (Gann et al. 2019, s7). Full recovery of an ecosystem is 'the state or condition whereby, following restoration, all key ecosystem attributes closely resemble those of the reference system' (Gann et al. 2019, s7). Although often framed as apolitical, ecological restoration cannot be understood as being outside its social, political and economic relations (Hodge and Adams 2016a; Osborne et al. 2021; Rai, Bhasme, and Balaji 2018; Scheidel and Gingrich 2020). Ecological restoration is a process that seeks to improve social-ecological systems. In so doing, it determines future land use and landscapes, as well as which actors are able to enact their visions of the future (Prior and Smith 2019; Wyborn 2015). The regulation (and, more generally, the governance) of ecological restoration is therefore a key component in the recovery of social-ecological systems (Richardson and Lefroy 2016).[42]

A recent institutional analysis of the regulatory frameworks across three case studies in Australia (mine rehabilitation and closure (MR&C), forest restoration and landscape restoration) demonstrates that, despite ecological restoration's potential, the regulatory

[42] Social-ecological systems are integrated and interdependent complex systems. As a concept, social-ecological systems do not differentiate between the cultural and natural, but rather recognize these systems as dynamic and relational (Berkes and Folke 1998; Biggs et al. 2021).

arrangements for the practice are hindering recovery in a number of fundamental ways. With most environmental regulation capable of being traced back to the state, the focus of the institutional analysis is predominantly on the role of state institutions and their relationships with key ecological restoration actors and regulatory frameworks. Fundamentally, the analysis finds that state institutions are facilitating ecological decline, rather than promoting recovery. This paper completes this multi-level institutional analysis to consider the re-design of regulatory frameworks for ecological restoration. It first sets out the key findings from the institutional analysis, before carefully setting out the methodology, approach and theory of change. Following Wright's (2010) typology of social transformations, it then proposes seven re-design strategies, grounding ruptural, interstitial and symbiotic strategies in the regulatory case studies and data collected from participant interviews. These strategies are: (i) regenerative interventions that address the underlying drivers of land degradation; (ii) redefining private property in law and regulation; (iii) place-based governance that allows for local community engagement and place-specific regulatory arrangements; (iv) 'commoning' in the practice of ecological restoration; (v) co-productive governance; (vi) autonomous regulators; and (vii) regulation that is temporally and spatially aligned with social-ecological systems. The findings are informed by the institutional analysis, participant interviews, and a comprehensive literature review. This paper adopts an institutional theory of change and assumes that positive social (including economic) and ecological change can occur within, and parallel to, current regulatory institutions.

This paper contributes to, and builds on, a bourgeoning scholarship that seeks to put forward diverse regulatory responses in order to challenge dominant neoliberal regimes and re-

imagine regulation for social and ecological wellbeing and justice (Parker and Haines 2018; Morgan 2015; de Sousa Santos and Rodríguez-Garavito 2005).

The environmental statehood of recovery

A multi-level institutional analysis (following Hurlbert 2018b) of three ecological restoration regulatory case studies across Australia was undertaken to determine key institutions, relevant regulation, responsibilities of the institutions, drivers of recovery for the institutions, and a qualitative assessment of the effectiveness of the institutions in achieving recovery. With most environmental regulation and many environmental conflicts capable of being traced back to the state, the focus of the analysis was on the role of state[43] institutions and the relationship of these institutions within the regulatory space for ecological restoration. The analysis found that four fundamental barriers to recovery exist within the regulatory space for ecological recovery.

First, the institutions and agencies tasked with facilitating extraction are often the same institutions that are tasked with facilitating the recovery of post-extractive landscapes. While this may not seem unusual when considered in light of the auspices of sustainable development, which assumes it is possible to extract *and* manage environmental externalities (Kotzé and Adelman 2022; Natarajan and Khoday 2014), this finding reveals that the regulation of restoration cannot be divorced from questions of land degradation. Until state institutions address the underlying causes of land degradation, recovery will

[43] The state here is understood as 'a process of exercising power via certain institutional arrangements' (Harvey 1976, 87).

continue to be impeded by ongoing extraction (Osborne et al. 2021; Bliss and Fischer 2011; Elias, Joshi, and Meinzen-Dick 2021).

Second, it follows from this first barrier that state institutions seek to legitimize and continue land-degrading activities. Regulatory institutions across Australia promote and incentivize resource development, thereby legitimising the practice by promoting its effect on the economic performance of the state through employment and wealth creation.

Third, the primary concern of regulatory institutions, when faced with the substantial negative economic, social and environmental consequences of extractive and land-degrading activities, is to limit state liability for these negative externalities. The primary driver of state institutions and the development of regulatory frameworks is risk minimization; the successful recovery of social-ecological systems is a secondary driver, and only in the way it related to the primary driver.

Fourth, when restoration is not a mandatory requirement, it is usually undertaken by non-governmental organizations. Non-mandatory or voluntary ecological restoration is significantly underfunded by state authorities (Samuel 2020); the response to this underfunding has been to turn to markets and private philanthropy to make up the shortfall. Mechanisms, such as carbon markets, biodiversity offset schemes and, more recently, a 'national nature repair market' (Commonwealth of Australia 2022; DCCEEW 2022) are touted as solutions to the shortfall. However, market solutions have been criticized for reducing social and political difference to the 'common' value of money, commodifying restoration (Boon and Prahalad 2017; Osborne et al. 2021) and potentially 'oversimplify[ing] ecosystems to the essential and marketable "nature that capital can see"'

(Osborne et al. 2021, 102320). As Galatowitsch (2009, 563) cautions, markets risk 'the market price … likely governing the quality of restoration, not the reverse'.

These institutional arrangements are symptomatic of what Ioris (2015) calls environmental statehood. This concept describes the way in which the state upholds and legitimizes land degradation by market creation and the regulation of natural resources, but simultaneously seeks to protect local communities and the broader public from the negative social and ecological consequences of these activities. Regulation is used to mediate political conflict and set boundaries of behaviour, with the state 'more than just the administration of public matters over resources and ecosystems, but … the affirmation of specific ideologies and techniques of socio-ecological organisation' (Ioris 2015, 167). Ioris (2015) argues that the core task of the modern state is to naturalize and maximize anti-commons institutions in the administration of the social-ecological impacts of resource production. In line with neoliberalism, the success of such tasks is measured by the market (Blalock 2014).

The arrangements of environmental statehood have been exported around the world through the processes of colonization, development and globalization. The Australian state is one product of these processes, with a 'a founding and ongoing political-epistemological-legal violence [which] means that "law" is taken to mean the law of the colonisers' (Davies 2022, 95). Despite this ongoing legal violence, pre-existing, non-dominant regulatory systems outside the neoliberal state persist, with First Nations people continuing to perform and enact their legal systems and care for country through laws, customs and relationships.[44] It is beyond the scope of this chapter to investigate the ways in which colonialism shapes the

[44] Recognized by the Australian state through the regulatory framework of the *Native Title Act 1993* (Cth) and associated regulation.

neoliberal environmental state or pre-existing legal systems could transform this dominant environmental statehood. Significant First Nations scholarship has engaged with these questions and the reader is directed to that scholarship (see for example, Country et al. 2020; Graham 2014; RiverOfLife et al. 2020; Suchet-Pearson et al. 2013; Watson 2017). However, considering the constitutive dualisms that maintain the ontological demarcations between human and nature within an environmental statehood, any transformation to this socio-political structure must simultaneously dismantle colonial structures and re-centre Indigenous (and other heterodox) law and knowledges.

Method

In setting out re-design strategies for ecological restoration regulation, this paper focuses on responses that directly challenge the conditions of an environmental statehood, as described above. The strategies are identified in line with the theory of change set out below. First, I describe the research method and normative assumptions of this paper.

Research method

Like many areas of law and legal research, environmental law research is most often described as doctrinal (Brooks 2017); however, this term is not readily understood and can refer to a broad range of practices (Burdon and Martel 2017; Fisher et al. 2009). Murphy and McGee (2015, 290–91) argue that 'at least for those looking from outside the discipline of law', legal research 'appears to be something lawyers do, rather than explain'. Environmental law research has also been critiqued for often aligning with liberal environmental law which,

Burden and Martel (2017) argue, assumes a problem/solution dichotomy that is strongly tied to positivistic thinking. This can result in research that seeks to mitigate, and sometimes facilitate, environmental impacts within a liberal system rationalized to the market (Alexander 2014), thereby failing to recognize that the failure of environmental law has been the system itself (Adelman 2015; Garver 2016; Grear 2015; Philippopoulos-Mihalopoulos 2011b). In response to these critiques, the research design of this paper has been carefully considered in line with critical environmental law theory and an institutional theory of change.

The research design is adaptive, with mutual dependency upon theory, empirical data and regulatory research (Layder 2021). This interdisciplinary and reflexive approach allows for explicit consideration of questions regarding a social reality, necessary for any exploration of the ideologies, values and norms of regulation and institutions (Layder 2021). This process utilizes both inductive and deductive analysis. The adaptive model proposed by Layder (2021) sets out three elements necessary for research that investigates questions of social reality. The first element is a generalising frame, which is a universal model of the social reality. This more global frame operates in dialogue with a second local frame, which is a particular and empirically informed image of the social reality, as detailed from the data. The third element involves reconciling these two frames by integrating theory and method, prioritizing explanation over description. The method of integrating theory with data collected from interview participants has been key to identifying the seven transformational strategies.

Like social constructivist approaches, I reject claims of researcher objectivity and affirm that 'researchers' and participants' relative positions and standpoints [are] critical (rather than

optional) elements of the research process' (Hordge-Freeman 2018, 3; see also Heath 2012; Stanley 2014), with the researcher a 'primary instrument of data collection and interpretation' (Stuart 2017, 211). The researcher is the constructor of reality which enacts and imagines worlds into being (Haiven and Khasnabish 2014). As Law (2004) notes, methods are constitutive of social realities; attempts to apply a methodology will inevitably result in a loss of certain analytical features. For these reasons, I set out a clear explanation of the theoretical underpinnings and normative positions of this paper, as well as the process by which analysis was undertaken, to make explicit my approach to this research.

This paper adopts three key normative positions. First, ecological restoration is a necessary practice to address biodiversity loss and climate change, and recovery of the complexity and functionality of social-ecological systems is an appropriate aim. Second, environmental law, as a complex adaptive system, must respond to, adapt to and manage the complex, adaptive social-ecological systems in which we live. This is encapsulated by the Conant and Ashby (1970, 89) theorem which states: 'every good regulator of a system must be a model of that system'. In line with complexity theory, I also recognize that the outcome of any legal reform cannot be known due to law's systemic interactions with society and the qualities of chaos, emergence and radical uncertainty (Ruhl 1996). Third, the democratic state and the rule of law is a social-political construct that can maintain democratic traditions and prevent authoritarianism and corruption (Davies 2022). It is not the only construct that can do so, but, in line with the theory of change set out below, this paper adopts Gramsci's (1973) conceptualization of the integral state, in which the state is conceived of as a process, capable of flux and change, with the balance of power always shifting across institutions and scales (Routledge, Cumbers, and Derickson 2018). Democratic participation should always inform

the arrangements of a contextually situated state (Asara, Profumi, and Kallis 2013 following Castoriadis; Routledge, Cumbers, and Derickson 2018). The identified strategies are put forward as challenges to the underlying ideologies of (neo)liberal states and their extractive orientation towards social-ecological systems. These strategies aim to transform the relationship between the state and nature towards one in which social and ecological wellbeing is the key objective.

Theory of change

Any problem-orientated research takes place within a theory of change. This paper adopts a theory of change that is institutional. According to Vatn (2009b), the main role of institutions—constituted by legal rules, norms and convention—is to indicate what is and is not appropriate behaviour. Individuals are socially created, with their norms and values having their origin in societal institutions: 'institutions are both external rules and constructs that shape the individual' which is internalized through social construction (Vatn 2009b, 2208). Institutions therefore help individuals to determine *what is*—what we have learned to observe—and *what should be*—the normative lens of what we have learned to respect and what can be considered relational social forces (Vatn 2009b, 2208). Institutional theory holds that ecological problems are not simply technological or economic and unidimensional, but political, behavioural and cultural (Hoffman and Jennings 2015). Ecological harm is legitimated by a legal and regulatory system that reflects underlying ontologies and cultural norms that elevate technological or economic development (Bazerman 2000).

By adopting an institutional theory of change, this research focuses on the role of the state, which is conceived of as a key element in social-political ecological change (Wright 2010). The state is not separate from society and does not act upon society; rather, state institutions (which develop and enforce regulation) include both civil and political society (Gramsci and Buttigieg 1992). This aligns with regulatory spaces theory, which examines the setting of the regulation in its political, legal and cultural contexts with historical timing, institutional and organizational structure, markets, social values and the nature of an issue all shaping the 'regulatory space' (Hancher and Moran 1989; 1998). According to Gramsci's (1973) concept of the integral state, political society exercises legitimate coercive power and enforces particular hegemonic ideological narratives; civil society is where these ideologies battle for hegemony. Without a broadly accepted ideology, political society cannot maintain its control, as change cannot be achieved by 'state-craft' alone (Morrow 2017). Cultural change is, therefore, fundamental to regulatory change. Regulation can be utilized to mediate conflicts over futures and sustainable transformation and is inextricably linked to political contestation (Parker and Haines 2018). D'Alisa and Kallis (2020) argue that this theoretical understanding of the integral state overcomes the common dichotomy prevalent in intervention reform proposals for sustainability (as either bottom up or top-down) without a clear view on the role of the state. In this analysis, 'the 'state is both a terrain of struggle *and* possibility' (Routledge, Cumbers, and Derickson 2018, 80), as critique can result in the transformation of new configurations of hegemonic power (Mouffe 2013). For these reasons, I discuss norms and value-setting in regulation.

In line with Wright (2010), regulatory re-design and reform proposals are classified below according to their potential systemic transformative ability. Wright (2010) sets out three

strategies of systemic transformation: ruptural, interstitial or symbiotic. Ruptural refers to the dismantling of existing state institutions and the construction of new ones, 'a radical disjuncture in institutional structures' (Wright 2010, 211). Interstitial transformations are those that build parallel systems within civil society but outside political society. A symbiotic strategy is a 'co-evolving trajectory of transformation based on compromises with the dominant political economic forces' (D'Alisa and Kallis 2020, 2). Through analysis of the collected data, this paper identifies ruptural, interstitial and symbiotic transformation strategies for social-ecological recovery, which are grounded in the data. The strategies discussed here are designed to be collective strategies that are not directed at individuals, but rather at systems.

Data collection

Through a process of purposive (Patton 2015) and snowball sampling (Campbell, Taylor, and McGlade 2017), key practitioners in ecological restoration across the three case study sites were invited to participate in a one-on-one, one-hour interviews. The regulatory case studies are (i) mine rehabilitation and closure (MR&C) situated in the jurisdiction of Queensland, Australia; (ii) forest restoration situated within the jurisdiction of Tasmania, Australia; (iii) and landscape-scale restoration situated across the various jurisdictions of Australia. Participants included strategic planners of ecological restoration, policy and regulatory experts, and implementation practitioners involved with the on-ground implementation of ecological restoration initiatives. In total, 37 participants were interviewed. An interview is defined as the elicitation of research data through the questioning of respondents (Wengraf

2001). The interviews undertaken for this research were qualitative and 'semi-structured', or 'in-depth' interviews. Interviews of this kind are more informal and conversational in character and are shaped by the interviewer's pre-existing interview guide, the themes that emerge during the interview and the experience and interest of the participant. Thirty-four interviews were transcribed verbatim and imported into NVivo 12 software to support the organization and analysis of the data. In line with the adaptive theory approach and the requirements of the multi-level institutional analysis, coding was a mix of emergent and pre-assumed codes. Data collected from participants' has been de-identified.

Following coding, a multi-level institutional analysis of the three regulatory case studies was conducted. Informed by Hurlbert's (2018) method but modified to focus on the regulatory elements of recovery, the multi-level institutional analysis has five elements: (i) regulatory institution analysis; (ii) regulatory instrument analysis; (iii) analysis of the regulatory drivers of recovery; (iv) the regulatory effects in achieving social-ecological recovery; and (v) regulatory re-design. For each case study, institutions that undertake, regulate or engage in some aspect of restoration were identified. Relevant laws, policies and regulations were then collected and categorized. The regulatory instruments were then analyzed to identify drivers of recovery and make a qualitative assessment of their effectiveness. This analysis was supported by a thorough review of previous studies, relevant pre-existing literature and research, as well as participant interviews. The first four elements are addressed comprehensively elsewhere in this thesis; this chapter addresses the fifth element, regulatory redesign.

Strategies for social-ecological recovery

The strategies outlined below are categorized in accordance with the three strategies of systemic transformation (ruptural, interstitial and symbiotic) but there is no clear delineation between the various types of strategy, with many overlapping and interrelated; for example, private property and commoning.

Ruptural reforms

> [A]s ecologists, we should challenge neoliberalism rather than accepting all developments as inevitable. [Participant]

Ruptural reforms are those that are a 'frontal attack on the state' (D'Alisa and Kallis 2020, 2), with the construction of new state institutions following the dismantling of the old (Wright 2010). Participants rarely raised institutional dismantling and reform. Unless they were representatives of a government institution, most participants expressed dissatisfaction with existing regulatory frameworks and institutions for ecological restoration. In most cases, the source of this dissatisfaction was the lack of institutional capacity, oversight and accountability, funding or the operation of markets and market-based approaches.

Adopting Gramsci's (1973) observation that cultural change is fundamental to changing the orientation of the state, and that the way in which we understand and imagine the natural world and the environment has 'implications for laws, policies and individual actions' (Neimanis, Åsberg, and Hayes 2015, 482), this paper sets out two particular ruptural strategies that have the potential to result in significant dismantling and reform of existing institutions. The first is what Osborne et al. (2021) call 'regenerative interventions'. These are interventions that address the root causes of land degradation and prioritize ecological

restoration and recovery over land-degrading activities. Associated with, and inherent to, regenerative interventions is valuing social and ecological wellbeing over financial return. The second ruptural strategy is a re-consideration of private property. As legal scholars identify (Davies 2021; Burdon 2015; Bartel and Graham 2019), the reformulation of private property in line with social-ecological wellbeing and relationality would introduce space for ontologies that allow for ecological complexity and diversity and that completely restructure the social-political-legal landscape. Both strategies could also be considered symbiotic transformation strategies, depending on the circumstances.

Regenerative interventions and prioritizing social and ecological wellbeing

> [R]estoration should be not just about the landscape. It should be systemic. It should be restoration of our governance. It should be restoration of our culture, if you will. [Participant]

Osborne et al. (2021), in their development of a political ecology playbook for ecosystem restoration, set out 10 principles across local, national and international scales. Principle 7 of this playbook promotes regenerative interventions; that is, initiatives that address the root causes of land degradation. This relates to Principle 8, which prioritizes social and ecological benefits over financial returns (Osborne et al. 2021, 5) and requires that markets be placed within social-ecological systems, rather than privileging the market above all else (Spash 2017; Daly and Farley 2010; Raworth 2022; Gibson-Graham, Cameron, and Healy 2013). Participants across the three case studies identified that the success and failure of ecological restoration is linked to questions of the economic, social, cultural and ecological value of recovery. Regenerative interventions in the regulatory frameworks for ecological restoration would, therefore, be orientated around limiting extraction, in line with social and

ecological wellbeing. Interventions could be instituted through appropriate statutory objectives that support and prioritize recovery over financial return, along with clear democratic mandates for such approaches to signal cultural change. This could result in a regulatory system that is no longer tied to growth, fundamentally re-orientating ecological restoration's environmental statehood.

> The only way you can overcome that kind of, you know, capitalism incentivising of self-interest is you have to have strong environmental and planning laws that actually override that. [Participant]

Regional, national and international trade and commerce arrangements would also need to be aligned with ecological restoration goals and objectives. Disincentives to ecological restoration would need to be removed and incentives for ecological restoration instituted, along with the associated removal of subsidies from extractive industry and land-degrading activities.

> The problem is … we're so focused on incentives which is the neoliberal argument … What it fails to do, and this is what I think we should do, is look at taking away incentives … before we talk about incentives … Why do we have dairy farming in northwest Tasmania that have wetlands?... We are … awash with milk …. Australia is obviously producing much more milk than we can consume and we are obviously exporting milk, mainly to China … So, here is a commodity, and it's been promoted and pushed into China into new versions of dairy products through advertising just because the commodity is cost effective to produce … So, when we talk about restoration, we never talk about any of these things **…** Obviously incentives are great. And we can see the cost and effect directly. But what we should do is look beyond that and look at how we can take out the disincentives from the system first before we talk incentives. And I think that would … be more valuable for restoration. [Participant]

Other participants suggested taxing carbon-polluting industries and activities to provide incentives for ecological restoration.

> What sort of schemes, can we put in place that incentivise restoration? Is it … looking at a tax on your flights when we're allowed to travel again and does that work? ... What schemes are out there already and what's the evidence that they're working and how can we ramp those up? [Participant]

Social and ecological wellbeing will need to be prioritized in the statutory objectives of management systems or regulators. Participants noted, for example, that the regulatory objectives for the Tasmanian forest system of meeting environmental, social and economic outcomes means that, on occasion, these objectives clash or are incompatible, which could lead to conflict and uncertainty over the appropriate regulatory response.

Changes to neoliberal paradigms have the potential to result in comprehensive system change; the difficulty of effecting ruptural change cannot be overstated, however (Meadows 2008). Deep, structural and institutional arrangements of inequality and power in both political and civil society mean that ruptural change will likely encounter active resistance from the status quo (Avelino and Rotmans 2009) and that such change will not be possible without a shift in the cultural hegemony of civil society. Only when the neoliberal paradigm is untenable will ruptural transformations, such as those articulated above, occur.

Re-defining private property rights and planning across tenure

> Here we are spending all of our efforts trying to grow trees and then in an adjacent paddock, a farmer can clear 40 hectares of native vegetation if he wants to on a permit. So that we've got this situation where here we are trying to restore landscapes to improve the condition … and we're

> still in the position … throughout Australia with regulations that allow wholesale land clearing. [Participant]
>
> Ownership shouldn't be the basis for conservation. [Participant]

Most of the land clearing and land degradation occurring throughout Australia is legally permitted and tied to the ways in which we conceive of private property. Private property emerges as a theme from many of the participant interviews. As the quotation above indicates, private property and economic rationalism can trump well-meaning environmental regulation when that regulation affects private property and corporate rights. As Freyfogle (1993, 49) writes, private property is a fundamental cultural narrative of environmental law: 'When lawyers refer to the physical world … they think and talk in terms of property and ownership'.

Participants expressed interest in two issues relating to private property. First, many within the landscape restoration space wanted to protect ecological restoration projects by utilising current private property tools, such as conservation covenants, to maintain restoration efforts in perpetuity. Where existing landholders did not agree to in-perpetuity covenants that attached to the land, stewardship models were used, which were contract based and did not attach to the land itself. The second issue for participants was finding regulatory ways to prevent property owners from undertaking land clearing and mandating or encouraging biodiversity management. Participants raised ideas, such as a land-clearing tax or regulatory mechanisms which require landholders to hold 30% of their property for biodiversity, or economic incentives which would facilitate biodiversity conservation and ecological restoration. While the first approach seeks strategies to maintain biodiversity within the

existing regulatory framework, the second requires reconsideration of existing regulatory arrangements for private property to maintain biodiversity.

Property rights were originally envisaged in law as a relationship between people and the land, but have since resulted in a relationship between rights holders, alienating rights from the land itself (Burdon 2015; Graham 2011). Private property allows for power to be accumulated and operationalized as private owners have power over non-owners, with very little restraint on the rights of private owners (Davies 2021). This rights-holder-to-rights-holder conception of private property has resulted in a broadening of the definition of property away from tangible property to intangible forms, such as intellectual property and copyright, thus '"elevating" the entire basis of property from natural rights to cultural rights' (Graham 2011, 138). The development of new forms of property (such as intellectual property) and the enclosure of the commons (through processes such as the privatization of public resources) is said to be essential to ongoing capitalist accumulation and reproduction, as well as the preclusion of anti-capitalist alternatives (De Angelis 2007; Fournier 2013; Turner 2017).

Legal scholars recognize that the current legal constitution of private property is strongly correlated with (perhaps even causative of) land degradation and needs to be radically re-imagined and reformed (Davies 2021; Graham 2011; Burdon 2015; Bartel and Graham 2019; Barritt 2014; Davies, Godden, and Graham 2021). Burdon (2015) argues that property law should be characterized, first, as an ecological relationship of rights and obligations, and, second, by social rights and obligations. Barritt (2014; 2019) amongst others (see, for example, Lucy and Mitchell 1996) argue for private property owners to be encumbered by obligations of stewardship. Davies, Godden and Graham (2021; see also Davies 2021)

reorientate private property within human and non-human habitats, while Keenan (2014) reconsiders property as being about belonging rather than exclusion. It is beyond the scope of this paper to propose a comprehensive reformulation of private property. The aim here is, rather, to canvass reformulation strategies that are relational and integrated for further consideration, noting that any reform to private property would of course require significant political commitment, the strengthening of the commons and political engagement, and would need to be negotiated in line with place-specific norms (Blomley 2013; Clark and Page 2019; Cooper 2007; Keenan 2014; Layard 2016).

Interstitial practices

Interstitial transformations aim to build parallel systems outside state institutions in the 'niches and margins' of existing systems (Wright 2013, 20). While these transformations individually may not be a significant challenge to the status quo, cumulatively they can enlarge the transformative scope of potential social and political reform. They must, therefore, be orientated around challenging the dominant forms of production and consumption or face co-option (as described below in the conclusion). The suggestions set out below emerge largely from grass-roots and community activism. While there is potential for such strategies to be categorized as symbiotic transformations, as regulation can provide opportunities for emergent local self-governance of socio-ecological systems (Ostrom 2005), this section focuses on the development of parallel institutions with regulatory capacity. Its focus broadens, in line with regulatory theory, to view regulation as a space where multiple actors regulate each other by setting objectives and agendas, implementing rules,

monitoring behaviour and undertaking regulatory review (Parker and Haines 2018; Hancher and Moran 1998; Lange 2003).

Community-led, place-based governance

> If there's one thing governments could do [it] is to strengthen that governance … they could harness the enormous power of civil society in a way that was beneficial to its own community, rather than harmful. [Participant]

> Something I've always felt is that, if you really want to make a change, you have to invest in a place. Pick a place and stay there. [Participant]

Participants across all three case study sites identified the key role that civil society and community participation plays in the practice of ecological restoration and recovery. Local community groups and individuals contributed labour, knowledge and resources, built and maintained political support, undertook oversight and provided accountability measures, particularly in relation to mandatory restoration, and developed and led non-mandatory restoration projects. The benefits of community involvement and engagement are recognized in the ecological restoration literature (Fernández-Manjarrés, Roturier, and Bilhaut 2018; Fleming et al. 2021; Gilfedder et al. 2021; Higgs 2005).

Ecological restoration, with broad stakeholder and community involvement and engagement, can ground and attach people to the places in which they live with deep metaphysical or emotional connections, motivating people to care for ecosystems beyond the services they provide or their aesthetics (Akhtar-Khavari and Richardson 2019a; Bartel and Graham 2019; Van Wieren 2008). Restoration can instil a sense of stewardship or responsibility with respect to land and property, restoring relationship to place (Barritt

2019; Bartel and Graham 2019) and the involvement of local and Indigenous people may result in subsistence-use activities, cultural practices, language and the exercise of spiritual responsibility to restore landscapes of 'human participation in ecological flourishing' (Kimmerer 2011, 260).

In relation to the institutional arrangements for community participation in ecological restoration, participants noted a number of potential strategies for increasing participation and community-led governance.[45] Allowing or encouraging local peoples to remain on country and continue to undertake active management of the landscape, whether that be Indigenous land management or regenerative farming activities, results in engaged and committed individuals, long-term management, intergenerational knowledge transfer, and positive social and economic livelihood outcomes, all of which contribute to an increased likelihood of recovery. Local people are a rich source of local knowledge. The enduring knowledge of local and Indigenous peoples and their highly specific and diachronic understandings of place, as well as philosophical and pragmatic prescription of values-led approaches to ecological restoration, can significantly contribute to recovery (Kimmerer 2011; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) 2018). Participants across the case studies supported governance arrangements that encouraged the inclusion of local knowledge and the recognition of the value of this knowledge.

[45] Governance is defined here as a practice and process that considers the exchanges between formal (legal processes and structures) and informal institutions (traditions, norms, rules, processes and structures) in decision-making, exercising responsibility and power distribution and accountability in the development, management and distribution of shared resources (Hurlbert 2018a, 23; Lebel et al. 2006; Cvitanovic et al. 2015).

Communities and local people were also identified as playing a significant role in ensuring a level of accountability when public regulators and regulatory arrangements lacked the resources and capacity to effectively oversee mandatory and non-mandatory restoration. As local communities do not leave when land-degrading industries do, they can be powerful advocates for ensuring functioning post-extraction land uses. Participants supported increased measures for community monitoring, feedback and input into governance arrangements.

Community-led governance of ecological restoration can transcend the semantic designations of top-down, uniform regulatory frameworks, and envision place-based approaches to governance situated in ecological systems (Telesetsky 2013). Much has been written about the importance of place in legal geography. Place, according to Bartel (2018, 65),

> co-produc[es] not just state and other laws, but its own legal order, comprising the unique biophysical and social features and constraints (ie 'rules') of place. These may interact and conflict with, as well as co-generate other legal orders … place law, co-created by us … may restrict, permit and promote certain human behaviours, through the material, biophysical and social factors, and ecological geomorphological and cultural features of places. These may be localized but are not always bounded, or small in scale.

The exact governance arrangements need to be negotiated from place to place but participants noted that community-led place-based governance can be supported through processes such as stewardship (Barritt 2019; Barritt 2014; Lucy and Mitchell 1996), bioregional planning (that is, planning designed to maintain the integrity of a bioregion (Berg 2009; Brunckhorst 2013)) or ecosystem management (Olsson, Folke, and Hughes 2008;

Schultz et al. 2015; Weber 2003; Vasseur et al. 2017). Community-led, place-based governance helps to identify and develop understandings of social-ecological systems, while recognizing that the human sphere is part of these systems—and reliant upon them—and creating multi-level governance arrangements to restore ecological connectivity, function and structure across landscapes.

Commoning

> Restoration should be a public investment. It's a public interest investment. We shouldn't wait for private investment or let it be determined by the market. It's a public good issue. And because it's a public good issue, we should invest in as a public. And the government has an obligation to invest in that public good. [Participant]

Participants in the landscape restoration case study identified restoration, along with biodiversity protection and ecosystem function, as being a public good. Participants noted, however, that existing private property and public land regulation was not established to centre these public goods or to adequately resource their management. As the quotation above indicates, one of the responses to this issue is to demand government action that recognizes and invests public funds in public goods. This might, for example, occur through regenerative interventions, re-imagined private property regimes, or through some of the symbiotic interventions identified below. In addition, and in conjunction with place-based governance, another identified interstitial practice is that of 'commoning'.

'Commoning' is a social process of organizing and producing around 'the commons' (that is the cultural and natural resources available to all people of the Earth/region/place) (Fournier 2013) and involves 'processes of sharing experiences of cocreation, self-

governance and reproduction of natural and social resources' (Baud et al. 2019, 268). Despite rational choice formulations of society that assume a 'tragedy of the commons' (Hardin 1968), Ostrom (1999; 1990; 2000), amongst others, conclusively demonstrates that common pool resources can be, and have been, effectively and sustainably managed by local communities outside privatization or government control. Anti-commons practices globally have significantly affected both land held in common and common resources and have resulted in habitat fragmentation, land degradation and biodiversity loss (Davies 2021; Clark and Page 2019). The enclosure movement, colonization, urbanization and globalization have displaced many people and reduced their living conditions (Federici 2021; Graham 2011; Polanyi 2001), with an associated loss of value accorded to public things (Layard 2016). Such processes are ongoing (Harvey 2017) and have significant ramifications for public good projects, such as ecological restoration. In response to these de-commoning processes, various scholars have called for a response that seeks to 're-common' the commons and resist neoliberal attempts at individualization and privatization (Fournier 2013; Turner 2017; Blomley 2008). Nascent research in relation to ecological restoration practices (Carrasco Henríquez and Mendoza Leal 2021) and community-based conservation (Quintana et al. 2021) is currently limited.

Commoning is, nonetheless, an appropriate interstitial response because it is about communities improving the management of resources through formalizing rules of access (Turner 2017). For ecological restoration, this means privileging local knowledges and practices and supporting these common property arrangements (Osborne et al. 2021). Favouring local knowledge and management has positive outcomes for conservation as a participant noted:

> Acknowledging and respecting the Indigenous ways of knowing, managing country – that leads to a new conceptualisation of conservation. We don't want to be going down the path of looking at wilderness areas because that never existed. We're looking at restoring the health of country through healthy people …. The stronger people are with an identity to a place, the more likely they are to respect it, and the more likely they are to manage it for multiple generations into the future and that is the key. [Participant}

Symbiotic

Aligned with social democratic movements, symbiotic transformation strategies simultaneously institutionalize and increase social empowerment, while stabilising existing systems and the status quo (Wright 2010). This results in apparent antinomies but can provide intermediate solutions and potentially provide an initial leverage point that may result in deeper system transformation. However, symbiotic strategies are at risk of being undermined or co-opted and require significant political commitment to overcome these risks. The focus here in setting out symbiotic strategies is on regulatory change but, without effective oversight, enforcement and political support, reforms will be ineffectual. Political risk can shape regulatory change but result in limited compliance (Parker and Haines 2018). For example:

> I know the [person] that is managing the protection of threatened species. They are so starved for funds and there are so many applications to clear landscape and conduct activities in areas that are designated as threatened but there are not sufficient people to go and make a report on the site before the approval is given … And it's just by design. The government wants to remove red tape, what they call green tape, and rather than removing it in this case – which is difficult to get

> it through an act of parliament – they just starve the institution managing it of any funds, so they can't actually perform the duty they're supposed to perform. [Participant]

Co-productive governance

> I just think we are trapped in this naïve position of, 'Well, we'll just do the science and that will be enough'. There is … this whole power structure outside which [we] probably wilfully … choose to be [ignorant of] 'cause you just don't want to be involved for very good reasons. [Participant]

Power and power relations were key issues for most participants. Institutional frameworks from the local to the national were identified as being representative of certain power arrangements, with industry capture of regulators and regulatory frameworks a common concern.

> Both sides of politics are receiving huge levels of funding … We're not being governed for the people, we're being governed … for profit, by heavy industry. [Participant]

As has long been recognized by political ecology, critical institutional theory and science technology studies, institutions are shaped by power relations, conflicting interests and values (Jasanoff 2010; Mehta, Leach, and Scoones 2001; Fabinyi, Evans, and Foale 2014; Cleaver and Whaley 2018). While it has been proposed that the solution to poor ecological restoration outcomes is to refine and increase the rigour of adaptive approaches in the governance of restoration projects (Jasanoff 2010; Mehta, Leach, and Scoones 2001; Fabinyi, Evans, and Foale 2014; Cleaver and Whaley 2018), adaptive governance has been critiqued for insufficiently attending to power structures (Cleaver and Whaley 2018; Karpouzoglou, Dewulf, and Clark 2016; Chaffin, Gosnell, and Cosens 2014) and assuming that institutions can be rationally crafted (Wyborn 2015). Without consideration of the values and power

arrangements inherent to projects employing adaptive governance approaches, adaptive governance can serve to facilitate the effective and ongoing extraction of resources. As Figure 2, below, indicates, adaptive governance can be operationalized under varying social and ecological value systems and approaches.

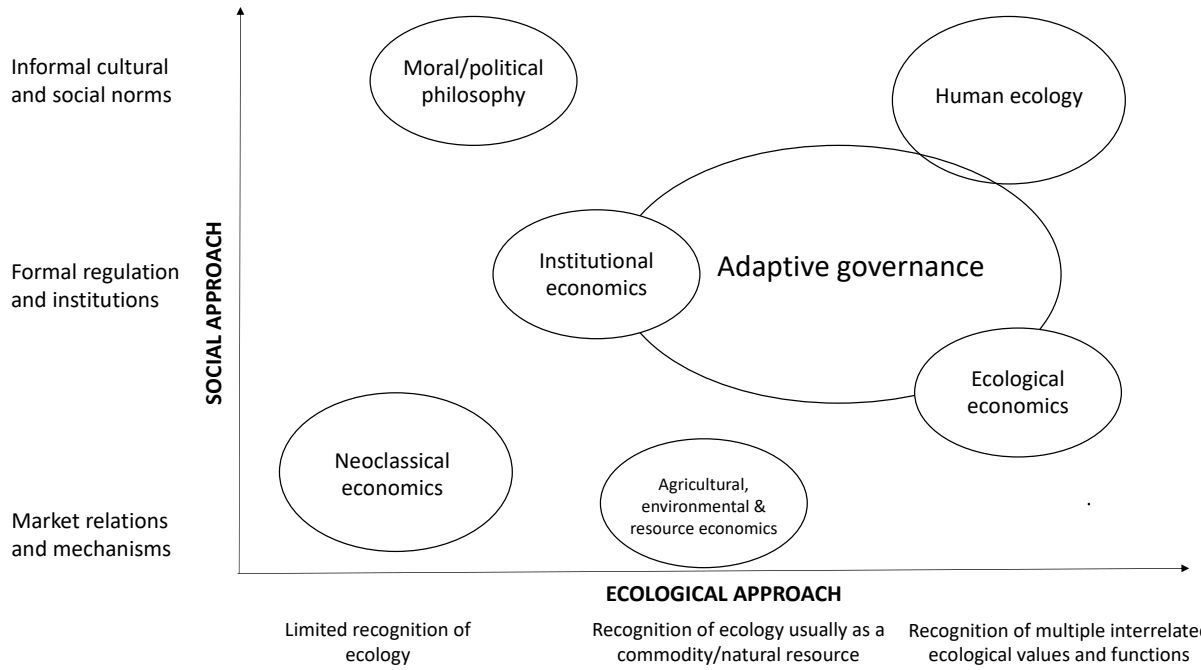

Figure 2: Situating the social and ecological approach of adaptive governance within various social, political, and economic theories (adapted from Hatfield-Dodds et al. (2007)).

In order to explicitly consider the manifestations of power and influence in social-system management, Wyborn (2015) and others (Chambers et al. 2021; 2022) argue for what has been termed 'co-productive governance'. There are other, similarly reflexive approaches amongst the social-ecological system governance research, sustainability transformation studies and institutional theory research, including a more reflexive approach to adaptive

governance, but this strategy will focus primarily on co-productive governance. Co-productive governance builds on iterative and collaborative learning governance approaches but focuses explicitly on the manifestations of power in science, practice and policy networks and considers the interactions between knowledge-making and decision-making (Chambers et al. 2022). It rejects the separation of science, practice and policy as specific domains and attends to the 'socio-political, normative and contextual influences shaping the use and uptake of knowledge' (Wyborn 2015, 58) to focus on collaborative knowledge production across science, practice and policy (Armitage et al. 2011; Chambers et al. 2022; Dilling and Lemos 2011; Jasanoff 2010; Lemos and Morehouse 2005). Co-production concerns facilitation between differing agendas through inclusive, reflexive processes that allow for difference to result in transformation (Chambers et al. 2022). The operationalization of co-productive governance is highlighted by Chambers et al.'s (2022, 3) analysis of 32 global initiatives. The synthesis of these case studies results in the identification of four collaborative pathways to foster system transformation through 'co-productive agility'. The first pathway elevates marginalized voices and agendas to maintain integrity, increase trust and social-ecological justice. This might be achieved through amplifying local and Indigenous voices (Hill et al. 2020) and increasing their legitimacy as experts (Tengö et al. 2017). The second pathway requires participants to question dominant agendas to increase inclusivity and avoid reinforcing power relations through co-option (Chambers et al. 2019). The third pathway navigates conflicting agendas by bringing actors together across various power differentials to transform paradigms, practices, institutions and policies. This contributes to an enabling political environment for transformation and requires iterative learning and consideration of the implications of system changes. The final

pathway respects plurality and makes a commitment to exploring diverse agendas, while creating a socially cohesive identity. This pathway is followed in the Conclusion, below.

Operationalizing co-productive governance within the regulation of ecological restoration would explicitly address participants' concerns regarding power and agency in a number of ways, including making dominant agendas explicit, including marginalized voices and bringing people and institutions together. It is a strategy that aligns well with the other strategies presented in this paper, including autonomous institutions set out below, and with the institutional theory of change.

Autonomous institutions

> The beauty of … an independent authority [is that they] can speak more forthrightly … [and] be a bit more forthright with the minister than maybe their departmental people [as they] have got that independence. [Participant]

Several participants identified regulatory institutions that were independent or semi-independent (for example, the Forest Practices Authority in Tasmania) as more effective than departmental organizations in the regulation of ecological restoration. Independence from line departments allows regulators to be somewhat immune to the vagaries of politics and political cycles; for example, funding periods that extend beyond political cycles allow regulators to undertake long-term approaches to regulation. That said, the Forest Practices Authority, faced criticism from participants for the limited opportunities it affords social and stakeholder engagement and participation, despite its adaptive management approach and commitment to science. Forestry in Tasmania continues to generate ongoing conflict between various institutions about the objectives of the forest management system.

Participants noted that institutions which undertake stakeholder engagement and stakeholder participation, including involving local people in restoration activities, result in better social-ecological outcomes. This is also well established in the literature, as explicit attention is paid to diverse knowledges and perspectives and the goals of the restoration (Fleming et al. 2021; Gilfedder et al. 2021; Higgs 2005) and can result in reduced conflict over the management of environmental systems (Fernández-Manjarrés, Roturier, and Bilhaut 2018). In line with these findings, this paper builds on participant suggestions and puts forward the concept of autonomous regulators to overcome the limitations identified above.

Autonomy, according to Castoriadis (1998; 1997a), is a reflexive and deliberative praxis that rejects rationalist and positivist traditions. An autonomous society is one that creates its own laws and is reflexive and aware that it is doing so (Castoriadis 1997b). According to this definition, autonomy requires civil and political society to recognize itself as the source of its own laws and norms. Autonomous institutions take responsibility for their own ideology and socio-political-historical influences and, through direct democracy, set forward the rules by which society agrees to be governed by. Autonomous regulators are independent but democratically informed and reflexive. Following Castoriadis, the knowledge base of autonomous regulators requires the democratization of the sciences to avoid science being used to maintain power or privilege scientific research and researchers above other knowledges and peoples. As science technology studies scholars argue, science is politically contingent (Latour 2004; Jasanoff 2010) and, like co-productive governance, autonomous regulators seek more equitable co-production of knowledge and partnerships.

Autonomous regulatory institutions could allow for the clear articulation of regulatory objectives through ongoing and direct democratic processes in an appropriate hierarchy aligned with community needs and aspirations. By being independent from political cycles, the funding of autonomous regulators should be long-term to allow for iterative long-term planning, management and monitoring. Autonomous regulators will also need to reflexively respond to a range of risks and contexts, both internal and external, and re-evaluate regulation in response (Baldwin and Black 2008; Black and Baldwin 2010). Any reflexivity to risk will need to be guided by broad and diverse democratic and community participation, as social and ecological justice is politically contingent on the representation of interests, values and peoples (Parker and Haines 2018).

Regulation that is temporally and spatially aligned to ecology

> If we could have 10-year plans, so that if there's a change of government, it doesn't matter that it changes. That programme is in place for 10 years, and, say, at the end of eight years, you go back and start renegotiating. But this two- or three-year funding, it's not long enough sometimes even to get the benefit of a programme. [Participant]

Participants across all three case studies identified a temporal disconnect between the process of recovery—which can take decades for the recovery of a mature ecological community, centuries for some landscapes and even millennia for the recovery of genetic diversity (Moreno-Mateos et al. 2020; Nilsson et al. 2016)—and the limited temporal oversight by regulatory institutions in the management of recovery. This gap is also noted in the literature (Richardson 2017). Participants noted that regulatory instruments for mandatory restoration often only require active management or oversight of restorative

activities for five to ten years, before a site can be relinquished. Financial support provided to non-mandatory restoration by state institutions is similarly limited, with financial arrangements usually being one to four years in length. Participants argued that regulation for mandatory restoration should require active management and monitoring for 20-50 years, depending on the particular system, and that funding arrangements for non-mandatory restoration should require management and monitoring for at least five years, with effective oversight and opportunities for further funding. Participants reported that they had to 'get creative' with funding in order to undertake ongoing monitoring and land management activities.

Participants also argued for regulation that is spatially aligned with social-ecological systems and noted the importance of landscape approaches to allow for ecosystem connectivity and diversity.

> When you think biodiversity, you have to think of multiple scales, going right down to the genetic scale … That's really important for animals … but genetic diversity for plants is super important. And when you have fragmented populations, there's all sorts of problems with inbreeding and … different things. So, it's quite complex. [Participant]

Habitat fragmentation and loss of connectivity across landscapes was a key concern of many participants because of its significant impacts on biodiversity and ecosystem function (Haddad et al. 2015). In response, participants suggested landscape-level planning and management as recommendations for regulatory reform.

There is no universal definition of a landscape approach to regulation (Sayer et al. 2013), but it is generally accepted that it is an approach that recognizes the interconnection of social-ecological systems, and that their function and processes are inherently complex (Newman

et al. 2019). Decision-making in this context is iterative and adaptive and takes account of multiple spatio-temporal scales, as well as cross-habitat linkages and energy fluxes that exist across the landscape (Weinstein, Litvin, and Krebs 2014; Sayer et al. 2013). From a social perspective, the landscape level is the scale at which 'identity to place' emerges (Wu 2012, 441), requiring integrated governance across multi-level jurisdictional boundaries, multi-stakeholder engagement and participation, and accountability (Sayer et al. 2013). The importance of stakeholder engagement, democratic participation and iterative learning is addressed in relation to autonomous institutions, commoning, co-productive governance and place based governance so the focus here is on the landscape from a spatial perspective. Landscape planning and management might require tenure-blind regulatory systems, as exists in the forest management system in Tasmania. Attention should also be given to supply chain and local material production

> Competing in a global economy is a really bad idea. So, forestry or timber production should be mainly based on local and regional supplies and supplying local regional needs rather than trying to compete in a global economy where you have to ... for it to be competitive, that means you have to mass produce things. It's all about volume and lowest standards. To be able to compete in the global economy, you really have to … have a lot of volume and you have to have weak environmental laws and low levels of protection and wages for workers and all that kind of stuff. [Participant]

Bioregional planning—that is, planning designed to maintain the integrity of a bioregion through situating material production within the capacity of bioregion (Brunckhorst 2013)—might be an appropriate response here.

Approach	Strategy		
Ruptural	Regenerative interventions	Re-defining private property	
Interstitial	Place-based governance	Commoning	
Symbiotic	Co-productive governance	Autonomous institutions	Regulation temporally and spatially aligned to social-ecological systems

Table 5: Summary of transformation strategies

Conclusion

Positivist approaches to law claim that there is only one set of institutions and practices within the nation-state capable of producing law, and that there is only one law (Davies 2022, 95). Escobar (2015, 14) calls this exclusionary concept of reality a 'one-world-world' (OWW), which effects a

> [t]wofold ontological divide: a particular way of separating humans from nature; and the distinction and boundary policing between those who function within the OWW and from those who insist on other ways of worlding. These (and many other derivative) dualisms underlie an entire structure of institutions and practices through which the OWW is enacted.

This mono-ontological framing has been exported around the world through the processes of colonization, development and globalization, 'fundamentally structuring the very horizon of possibilities for who and what has legal rights and standing' (Boulot and Sterlin 2021, 2). Law within this context 'signals a self-serving set of rules that imperialize the desires of the powerful' (Escobar 2015, 19; see also Borrows 2016; Mills 2016; Law 2015).

Despite legal positivism's best efforts, we do not live in a single reality (Davies 2022, 105). Reforms that seek to acknowledge the complexity of social-ecological systems must

recognize that universal law and governance frameworks do not exist (Ostrom, Janssen, and Anderies 2007). In line with complexity theory, diverse regulatory responses are required for social and ecological wellbeing (Parker and Haines 2018). The strategies outlined above are not designed to be a conclusive summary of the regulatory strategies capable of transformation in relation to ecological restoration (see Campbell, Alexandra, and Curtis 2017, 410). Rather, they contribute transformational exemplars that prioritize social and ecological wellbeing and directly challenge a neoliberal environmental statehood. These strategies are not universalizing; neither do they adopt a relativist position. Democratic common good and social and ecological wellbeing are to be prioritized in any regulatory reform, with the direct participation of local communities (in line with their specific social, ecological and cultural understandings) to determine what the common good looks like from place to place and over time. The outcome of such collective creation and praxis cannot be known. The challenge for regulatory systems will be to support multiple strategies and approaches (Parker and Haines 2018) in pluralist democracies (Laclau and Mouffe 2001). These processes will inevitably require significant re-invigoration of democratic participation models, as neoliberalism has sought to replace an individual's political and democratic participation with activity in the market (Brown 2017; Blalock 2014).

As Parker and Haines (2018, 150) observe, 'A focus on how regulation *should* occur glosses over the political, social and economic challenges that will be faced in ensuring it *does* occur'. The institutionalization of transformational strategies will require attention to the processes of change, while proponents and movements will need to identify appropriate windows of opportunity to effect change. Knowledge mobilization research demonstrates that finding the right times to act ('windows of opportunity') is essential to effective research-to-policy

translation (Cvitanovic et al. 2015; Cairney and Kwiatkowski 2017; Kingdon and Thurber 2011; Kingdon 2010; Meijerink 2005). The same is true for system transformation. As DeCaro et al. (2017) identify using panarchy theory and institutional theory (see Figure 3), social-ecological systems undertake dynamic cycles of change, resulting in opportunities for innovation, governance regime change and paradigm transformation with three key steps: (i) preparing a system for change; (ii) navigating a transition in the governance remine when a window of opportunity emerges; and (iii) consolidating the new regime (DeCaro et al. 2017; Gunderson and Holling 2002). In a study of sustainability transformation, Herrfahrdt-Pähle et al. (2020) identify socio-political shocks as opportunities for regime change, as well as new governance and institutional models.

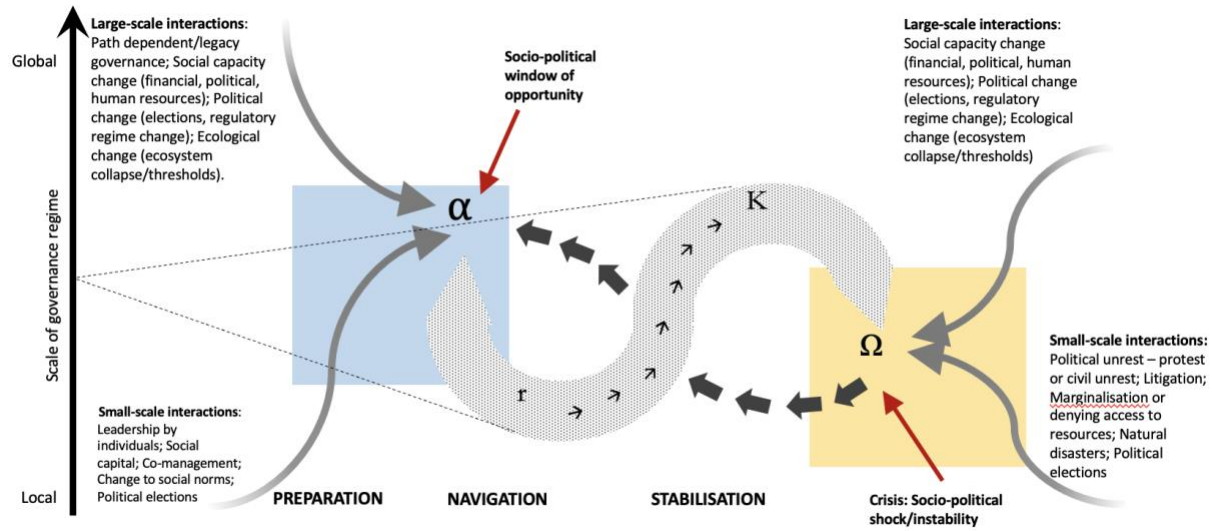

Figure 3: Transformation cycles of social-ecological systems (adapted from DeCaro et al. (2017), Chaffin and Gunderson (2016) and Herrfahrdt-Pähle et al (2020)). This image represents the potential adaptive cycles of social-ecological systems with social-ecological systems developing structure and complexity over time. Following a 'Window of opportunity', exploitation (r) of a particular governance approach or paradigm preferred by either political or social institutions can be expected before being followed by conservation (K), where stabilization, consolidation and entrenchment of the preferred governance approach or paradigm will be sought. Ω refers to crisis or instability, where limitations lead to paradigm collapse, followed by reorganization (α), where opportunities for the re-structuring or transformation of paradigm or governance arrangements might occur. 'Windows of opportunity' represent opportunities for transformation.

Strategic transformations will also need to avoid co-option within the existing neoliberal environmental statehood. Gramsci (1973) calls co-option 'hegemony through neutralisation': transformative strategies, aiming to challenge existing institutional hegemonies, are appropriated by the existing system, thus neutralising their potential (Routledge, Cumbers, and Derickson 2018). Examples include the concept of sustainable development, which has been criticized for maintaining development (Kotzé and Adelman 2022), or the inclusion or instrumentalizing of traditional ecological knowledge in environmental management without truly paying attention to the ontologies and world-views in which that knowledge is situated (Tully 2018). The risk of co-option requires that the implementation of transformation strategies follow a process that is reflexive and includes inbuilt auditing processes, to ensure that objectives are met and that systemic change is at its heart.

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List of figures and tables

Discussion of findings

This thesis presents the findings from an empirical analysis of the regulation of ecological restoration across three case study sites in Australia. Chapter 1 explores the ways in which environmental law and regulation responds to uncertainty and complexity in the management of complex, adaptive social-ecological systems. To ground the analysis, Chapter 1 introduces the practice of ecological restoration (a process that seeks to assist the recovery of degraded ecosystems) to investigate the manner in which environmental law regulates social-ecological systems. The focus on ecological restoration continues across the entire thesis. Chapter 1 investigates the regulatory frameworks for ecological restoration and notes that there are significant gaps in its regulation. A review of the scholarship on the topic of ecological restoration, regulation and governance finds adaptive approaches, such as adaptive management and adaptive governance, are strongly supported. The chapter concludes by proposing 'restorative inputs' – an additional dimension to adaptive approaches that aim to build and add complexity into a system.

Chapter 2 applies a comparative case study analysis to determine whether an adaptive governance approach to regulation is an appropriate response for the regulation of ecological restoration. Ultimately, Chapter 2 finds that adaptive regulatory responses, while helpful, do not address the underlying drivers of land degradation and do not necessarily result in recovery.

Chapter 3 examines the regulatory drivers for ecological restoration through a multi-level institutional analysis, and finds that the regulatory institutions for ecological restoration seek to maintain and facilitate economic development, extraction and land degrading

activities while simultaneously avoiding the negative environmental, social and economic externalities associated with land degradation.

Chapter 4 completes the institutional analysis undertaken in Chapter 3 and, in line with Wright's (2010) transformation strategies, sets out seven strategies for the transformation of the regulatory systems for ecological restoration. These are not intended to be universalising strategies and are instead designed to be democratically negotiated in line with the specific spatial and temporal needs and values of communities.

Across the thesis chapters, a number of key themes emerge. First, this thesis demonstrates that the reform of existing environmental law and regulation that regulates ecological restoration to ensure it is more adaptive and accountable may not be sufficient. There has been significant investment and reform in ecological restoration standards, processes and market development in Australia. Much of that reform has included consideration of approaches aligned with the adaptive governance characteristics set out in Chapter 2. Indeed, adaptive management and iterative learning across all three case studies was found to be well accepted, along with the requirement of stakeholder engagement and participation. Despite these commitments, however, ecological restoration is struggling to effect recovery within existing regulatory systems. A parliamentary review into the NSW Biodiversity Offsets Scheme in late 2022 found that there was 'no guarantee that like-for-like offsets will ever be found', holding ultimately that the biodiversity market in NSW was failing to deliver (Parliament of New South Wales 2022, ix). Another recent critique of the federal system undertook spatial analysis of 15 years of decision-making under the EPBC Act and found that there was no significant difference in habitat loss under significant and non-significant determinations for threatened species, migratory species and threatened

ecological communities (Maitz et al. 2022). From a regulatory perspective, it would seem that the 'road to ongoing extraction seems to be paved with the best intentions of existing environmental law and governance models' (Boulot et al. 2021, 2).

The reasons for such regulatory failures are myriad and complex, not least because ecological restoration itself is a long-term process situated within complex systems. But as this thesis has demonstrated, the challenges go deeper than developing better planning processes, developing offset schemes, streamlining processes and increasing investment (as proposed by the Australian federal government: DCCEEW 2022). Environmental law and regulation across Australia is insufficient because of its underlying ontology. Any reform to regulatory regimes for the purposes of effecting social-ecological recovery will need to focus on preventing land degradation in the first place, restoring people to place, as well as ensuring adequate oversight, accountability and funding for ecological restoration over long time periods.

Another key theme across the chapters is ecological restoration's close alliance with (and potential co-option by) markets and monetary valuation. The Australian Government's response to the *Samuel Report* (2020), the *Nature Positive Plan: Better for the Environment, Better for Business* (DCCEEW 2022), demonstrates this point. This plan commits the federal government to sustainable economic development and a national nature repair market, along with conservation and accountability measures that tie restoration of social-ecological systems to economic development and growth. The DCCEEW (2022) plan seeks to envision a regulatory system that simultaneously restores nature while ensuring that Australia manages its economy in line with growth-based approaches. The economy in this plan, is an institution that sits outside both society and ecology, with the government's response failing

to acknowledge that market activities have driven much of Australia's environmental decline and that the commodification of social-ecological systems will only continue environmental decline. While alluring, concepts that commodify nature, such as Payments for Ecosystem Services have been roundly critiqued for a range of varying reasons. Norgaard (2010, 7) writes for example: 'environmental governance can no more succeed around the metaphor of ecosystem services apart from the richness of ecological thinking than mortgage markets can succeed on the myth that housing prices will always rise … Somehow, we need to make a significant transition toward richer ways of understanding and governing'. Without paying close attention to the manner in which the state and associated environmental regulation is orientated around resource use, marketization and upholding hegemonic neoliberal ideologies, land degradation will continue, and will continue to impede the recovery of social-ecological systems. The research findings from this thesis demonstrate that what is needed is reform that seeks to prevent further land degradation and repairs existing degradation. The strategies in Chapter 4 provide examples of regulatory reforms that are orientated towards the prevention of ongoing land degradation and the recovery of social-ecological systems.

Finally, as the literature that supports this thesis evidenced, there is a continuing gap between bottom-up and top-down approaches in considering adaptive governance, ecological restoration and sustainability transformation research. The emergence of localized, bottom-up approaches to the management of social-ecological systems has been criticized for being ad hoc and not happening sufficiently swiftly to combat environmental decline (Cosens et al. 2021) with top down approaches criticised for their lack of inclusion of local people (Bayrak and Marafa 2016; Osborne et al. 2021) and often poor oversight or

outcomes. Regulation is said to play a key role in response by facilitating more co-ordinated systematic approaches to recovery and in operationalizing environmental management that is orientated towards the public good (Chaffin, Gosnell, and Cosens 2014; Cosens et al. 2014; 2021; Nagarkar and Raulund-Rasmussen 2016; Ostrom 2005; Wyborn and Dovers 2014). This research gap that fails to consider and merge top-down and bottom-up approaches has significant consequences for the research into and implementation of many environmental management and governance initiatives. Consequences include failing to identify pathways for more systematic delivery of environmental governance for the public good and failing to identify the key role that the state (and large institutional bodies) can have upon the regulatory environment. By examining both bottom-up and top-down approaches to the practice of ecological restoration, this thesis sought to merge these two scholarly fields and develop findings that drew on the marriage of both approaches.

What do the findings mean for the UN Decade on Ecosystem Restoration?

This thesis has been undertaken during the UN Decade on Ecosystem Restoration, a global initiative designed to prevent biodiversity collapse and restore degraded ecosystems across land and sea. To situate this thesis' research findings globally, the key themes and findings are considered in relation to the UN Decade.

Much has already been written on what key principles for the UN Decade should be developed, along with research into nature capital, climate change adaptation, and the inclusion of local communities and social elements (see Barragán et al. 2022; Cook et al. 2019; Fischer et al. 2021; Jones and Murphy 2021; Meli et al. 2022; Nskikani et al. 2022

amongst others). This is a burgeoning area of research as it has been recognised that ecological restoration at the international level faces similar challenges as the Australian domestic landscape and requires improvement. For example, very few Parties to the Convention on Biological Diversity have met the 15% restoration requirement under the non-legally binding Aichi Target 15 (Secretariat of the Convention on Biological Diversity 2020). The Reducing emissions from deforestation and forest degradation (REDD+) program has also been criticised for failing to deliver on forest conservation and reducing deforestation (Thales et al. 2020) and for disrupting and failing to include local peoples (Bayrak and Marafa 2016). The Bonn Challenge (another key program involved in the UN Decade) has been criticised for allowing countries to set plans envisioning commercial plantations of monocultures rather than natural forest restoration (Lewis et al. 2019).

This thesis makes some additional contributions to this existing critique. First, this thesis demonstrates that state-making, maintaining and operation is heavily tied to resource extraction. Regulatory systems and regimes are essential to the commodification of natural resources and the maintenance of markets. This means that international environmental law and programs, such as the UN Decade, face significant challenges in their adoption and successful implementation. Despite international environmental law and international environmental programs being quite a distinct regulatory environment at the international level, they are limited by being usually voluntary or of a 'soft' or non-binding nature. This limits effectiveness and integration both horizontally (across various international legal regimes) and vertically (from the international to the national level). Further research is required here to suggest approaches that not only transcend national concerns around the consolidation of state power through resource development, but also to put forward

programs and regimes that can integrate throughout the international regulatory environment.

The second point is that markets and market-based approaches for ecological restoration are not the solution to the underfunding of ecological restoration efforts. This is not a new contribution. Criticisms of market-based approaches such as payments for ecosystem services, biodiversity offsets and carbon offsets have been made at the regional and international level (Greenfield 2023; Kolinjivadi et al. 2019; McGee and Steffek 2016; Thales et al. 2020; for a discussion of the EU carbon market see Lange 2015). This means that funding for ecological restoration must be found elsewhere. Funding might be through the national and international taxation of national and multi-national polluting and extracting industries and companies for example, or other regulatory mechanisms of wealth redistribution. Finally, as has been raised by numerous scholars, global approaches must take into consideration the specific local social and ecological conditions in order to have successful recovery (Bayrak and Marafa 2016; Osborne et al. 2021). International regulatory regimes were not the focus of this research, but research in this space suggests that the international regulatory environment lacks the particularity to mandate or encourage the development of complexity and the recovery of social-ecological systems. For example, global programs such as the Bonn Challenge, REDD+ and the Aichi Targets have all been criticised for failing to prevent mono-culture plantations under their regulatory regimes.

Limitations of the research

In relation to the investigation of the research objectives, there were two particular limitations. In relation to Objective 3 (To determine whether an adaptive approach to regulation is an appropriate response to high levels of uncertainty in complex, adaptive socio-ecological systems), the research and analysis undertaken to answer this research question did not measure biodiversity markers, social determinants, ecosystem function or other recovery indicators to compare recovery and regulation. This means that the response to this research objective cannot conclusively answer the question of whether adaptive approaches to regulation have a causative relationship to ecological recovery. The research was instead guided by the experiences of the participants and their input into the comparative case study. This is a limitation of the research, as it relies upon the normative judgement of the researcher and participants. But it is also a strength, as it allows for the research to be guided by the knowledge and experience of the various participants. It is also an area of future research as discussed below.

In relation to Objective 5 (To identify important elements for the design of regulatory frameworks that can facilitate recovery), the impact on recovery of the transformative strategies outlined in Chapter 4 has not been empirically assessed. Following on from the findings of Chapter 3, it is assumed that the orientation of regulatory frameworks which implicitly or explicitly legitimate land degradation does have a deleterious impact on social-ecological recovery, as do regulatory frameworks that further commodify ecological restoration. The transformative strategies that are identified in Chapter 4 are therefore aimed at preventing land degradation and promoting social-ecological recovery. These strategies are drawn from the data collected from the research participants and their

suggestions for regulatory reform, as well as from the theory set out in Wright's (2010) strategic approach.

Research for this thesis was also limited in a number of ways by the Covid-19 pandemic. Due to travel restrictions, visits to field sites were limited and initially envisioned ethnographic field work was not undertaken. The Covid-19 pandemic also impacted the scope of the analysis in relation to the mining rehabilitation and closure (MR&C) case study. The research plan originally involved visiting MR&C sites, engaging with local communities and mine site personnel, using both qualitative and quantitative methods. Interviews with Indigenous landholders were also intended which required additional ethics approval in line with the *Code of Ethics for Aboriginal and Torres Strait Islander Research* developed by the Australian Institute of Aboriginal and Torres Islander Studies. However, due to the public health risk that this research posed to potential participants, as well as time and resource constraints, the decision was made to focus primarily upon desk-based research and participant interviews, either in person or by Zoom depending on the location of the participant. The lack of First Nations perspectives in the research is a serious limitation and one that deserves further research.

The research plan originally also involved quantitative analysis through a survey of ecological restoration practitioners to allow for data triangulation and validation. These participants were to be recruited from the field sites and elsewhere, but outside the interview participant pool. Despite substantial efforts to recruit participants, responses to the survey were limited (n=19); due to the small sample size, quantitative analysis was not undertaken.

Future directions

Knowledge dissemination and exchange

The first step following thesis submission is knowledge exchange. Knowledge exchange refers to the 'the interchange of knowledge between research users and "scientific" production' (Cvitanovic et al. 2015, 26). As Cvitanovic et al. (2015, 26) write, knowledge exchange is a key factor in 'facilitating the social, environmental and economic impacts of research, thus improving the sustainable management of natural systems and the goods and services they provide, and in turn ensuring the safety and wellbeing of the people that depend on them'. This initial phase will therefore involve informing participants of the outcomes of the research. All participants will be emailed with a plain English summary of the results from the research, with full papers available on request along with their interview transcripts. Following this, a policy brief will be prepared. This brief will be developed to be disseminated to relevant regulatory institutions identified in the research. In line with multiple streams theory (Kingdon 2010), the policy brief is intended to be flexible and adaptable to emerging 'windows of opportunity'. For example, the current federal government in Australia has indicated its intention to protect 30% of Australia's landmass and marine areas by 2030 and to establish a national nature repair market (Commonwealth of Australia 2022). The relevant government department is intending to consult on the development of this national nature repair market and its strategies on biodiversity protection and the reform of the EPBC Act's operation (DCCEEW 2022, 23). I aim to engage in these public consultation processes and communicate the results from this research into

that consultation process. I also expect there to be ongoing opportunities to communicate findings to reform processes in relation to MR&C in Queensland and forest restoration in Tasmania. Limiting state liability for MR&C is a significant consideration for both state and federal governments with ongoing reform and interest. Forest restoration in Tasmania continues to be of ongoing interest to the Forest Practices Authority and it is very likely that there will be opportunities to engage in knowledge exchange with the next update to the Forest Practices Code.

Future potential research

One of the limitations of the research identified above concerns the relationship between adaptive governance and social-ecological recovery (Objective 3). Future research is therefore proposed to investigate this relationship, both quantitatively and qualitatively. This research will necessarily require an interdisciplinary approach. Quantitative research in restoration ecology and conservation biology can assist in the determination and measurement of recovery indicators for ecological restoration. Qualitative research from the social sciences is also required to determine and assess the indicators for social recovery in social-ecological systems. Social sciences can elucidate the cultural beliefs, norms, values and rules of local communities which, when included as the foundation of decisions, will increase the likelihood of success (Mascia et al. 2003). Such research will additionally require input from governance and regulatory scholars in the design of the research and analysis.

Future potential research could also be undertaken to validate the transformation strategies outlined in Chapter 4. Many of the strategies identified in Chapter 4 have been relatively underexplored. For example, there is limited research on the overlap between commoning

and ecological restoration (Carrasco Henríquez and Mendoza Leal 2021), despite the potential of this strategy. The identification of regulatory frameworks in other subject areas that have leveraged system change orientated towards social and ecological recovery or wellbeing is another potential area of research, along with investigation into the identification of key features of autonomous regulators.

Another key issue, that was underexplored in this thesis but is evident across all of the chapters and from the data collected, is the potential for ecological restoration not only to restore ecological integrity, but also to restore culture and the ways in which we relate to the world around us, recognising that we are formed by, bound to, and in interaction with, the human and the more-than-human (Kimmerer 2011). As a practice that is often rooted in place and in people, this provides a case study of 'the way things ought to be in the face of the way things currently are' (Van Wieren 2008, 246). The challenge is, therefore, to orientate law and regulatory systems towards a practice of reciprocity (see, for example, Mills 2016) which values and respects social-ecological complexity and wellbeing. There is potential further research in this area that could investigate the relationship between cultural restoration and law and regulation, an under-explored area of research. This will necessarily require consideration of First Nations perspectives and potential leadership and involvement. Much of this work and shift in thought is coming both at the behest of indigenous peoples, and in consideration of their long-held understandings, relationships and relations to social-ecological systems.

In order to produce the knowledge required for social transformations for sustainability, it has been suggested that transdisciplinary research is an appropriate methodology to address the complexity inherent to such processes (Mauser et al. 2013; Hirsch Hadorn et al.

2006). There are many definitions of transdisciplinary research, but it is widely accepted that transdisciplinary research is goal-orientated and intended to create change (Mitchell, Cordell, and Fam 2015) and involves a plurality of perspectives (Vienni-Baptista et al. 2022) and academic and non-academic participants (Mauser et al. 2013). Any future research should carefully consider the adoption of a transdisciplinary approach.

Conclusion

> *The old world is dying and the new world struggles to be born. Now is the time of monsters* (Antonio Gramsci, translated liberally by Žižek 2010).[46]

As has been extensively detailed within Australia and across the globe, our social-ecological systems are in decline (Cresswell, Janke, and Johnston 2021; IPCC 2022; Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) 2018; Samuel 2020). This decline has been legitimated and maintained through legal and regulatory regimes. The 'monsters' of Gramsci's 'interregnum' are therefore the legal systems themselves. Environmental markets, biodiversity offsets and sustainable development, amongst many other regulatory tools and approaches, continue to prevent the recovery of social-ecological systems. Liberal Western law finds itself the facilitator of decline, unable to escape an ontology that views nature as 'other', a resource available for annexation resulting in a paradox that prevents regulatory systems from supporting flourishing social and ecological systems. Chapters 1 and 3 of this thesis explore these challenges in detail. In Chapter 2, we see that even as systems adopt more flexible and adaptive approaches, these 'morbid symptoms' persist. Indeed, flexible and adaptive approaches to regulation can result in more effective resource accumulation and land degradation. However, not everything is at risk of co-option. Amongst the 'morbid symptoms' of social-ecological decline, glimmers of potential new worlds exist. Regulation that places social and ecological wellbeing as its objective, as well as regulation that is spatially and temporally orientated towards ecological

[46] The translation by Žižek (2010) is a liberal one. The quotation from Gramsci (1973, 276) has been more usually translated as: 'The crisis consists precisely in the fact that the old is dying and the new cannot be born, in this interregnum a great variety of morbid symptoms appear'.

restoration and recovery are some such glimmers. Further glimmers can be found in Chapter 4.

This thesis has set out answer five Research objectives, as set out in the Introduction. Objective 1 (To examine how traditional environmental law and regulation responds to the high levels of uncertainty present in complex, adaptive social-ecological systems) is comprehensively explored in Chapter 1 and further explored in the first part of the Literature review. In order to ground the discussion, Chapter 1 introduces the practice of ecological restoration and its regulation as an example of a practice that is complex, adaptive and is situated within complex, adaptive social-ecological systems. Through analysis of the literature and two case studies, Chapter 1 found that environmental law, regulation and, to a large extent, governance, is woefully inadequate in managing 'the environment'. Environmental law and regulation takes an ontological approach that is fundamentally oppositional to complexity. As the Samuel review of Australia's leading federal environmental legislation, the EPBC Act, identified, legal systems are contributing to decline (Samuel 2020). Ecological restoration regulation across multiple industries and jurisdictions is similarly failing to meet the objective of recovery (New South Wales Parliament 2022; Queensland Audit Office 2013; Queensland Treasury Corporation 2017; Samuel 2020). Chapter 3 continues the exploration of Objective 1 by undertaking an institutional analysis of the ecological restoration regulatory space. Chapter 3 finds that ecological restoration is impeded by a regulatory system orientated towards extraction, with regulatory frameworks simultaneously seeking to legitimate land degradation and repair degraded landscapes. Despite a narrative that assumes it is possible to 'borrow' from nature (Trigger 1997), social-ecological systems rarely recover fully (Jones et al. 2018). Regulation for ecological

restoration is also tied to limiting state liability for social and ecological externalities and developing market opportunities for investment in ecological restoration.

Objective 2 (To investigate the regulation of ecological restoration) is answered across Chapters 1 to 3. The answer to this question is limited to three regulatory case study sites in Australian jurisdictions (state and national): Case Study 1 examines mine rehabilitation and closure (MR&C) in Queensland; Case Study 2 examines forest restoration in Tasmania; Case Study 3 examines landscape restoration across Australia. The regulatory framework tables in Chapter 2, along with the institutional analysis in Chapter 3 and Appendix 5, summarize the regulatory frameworks and spaces across the three case studies. Case Studies 1 (MR&C) and 2 (forest restoration) are explored in Chapter 1. It must be noted that, since the publication of that chapter as a manuscript, reforms have been made to the regulatory framework for MR&C in Queensland and readers are referred to Chapters 2 and 3 for a summary of recent reform.

Chapter 2 explores Research objective 3 (To determine whether an adaptive approach to regulation is an appropriate response to high levels of uncertainty in complex, adaptive socio-ecological systems). The chapter investigates the extent to which the regulatory frameworks of the three case studies adopt four key adaptive governance characteristics, before considering the extent to which the adoption of these characteristics is appropriate. As noted in the Discussion, this research cannot quantitatively determine whether there is a causative relationship between adaptive approaches to regulation and increased recovery. This thesis takes a regulatory and social sciences approach with the case studies orientated towards the regulatory space, not particular sites of ecological restoration and recovery. Metrics related to social and ecological recovery are, therefore, not assessed. Instead, the

research findings in relation to Objective 3 are guided by the experiences of the interview participants and analysis of the collected data. This is a limitation of the thesis and an area for potential future mixed-methods research to further investigate the validity of the research findings.

Chapter 3 addresses Objective 4 (To investigate the regulatory drivers for ecological restoration and consider the effectiveness of regulatory institutions for ecological restoration) through a comprehensive institutional analysis. This multi-level analysis identifies the arrangements of institutions and regulation for ecological restoration and the drivers for ecological restoration regulation and includes a qualitative assessment of the effects of those drivers on recovery across all three case studies. Applying the adaptive theory model of research, the findings from the institutional analysis are merged with theory concerning environmental statehood and neoliberalism to investigate the regulatory drivers for ecological restoration.

Chapter 4 addresses Research objective 5 (To identify important elements for the design of regulatory frameworks that can facilitate recovery). Drawing on the findings of Chapter 3, it is assumed that the environmental statehood (as detailed in Chapter 3) impedes the recovery of social-ecological systems by continuing to legitimate land degradation. A second assumption made in this chapter is that regulatory frameworks orientated towards social and ecological wellbeing and away from market-based approaches will necessarily contribute to recovery. This assumption cannot be conclusively substantiated without further research. The investigation of the effectiveness of these strategies is another further area of research. Given these assumptions in Chapter 4, the theory of change and method is carefully articulated. Applying the theory of change to the regulatory space, transformation

strategies are then identified informed by research participant data and grounded in the case studies.

Law and regulation is, at its core, an expression of the nature of human community (and relations with the more-than-just human community) and its ordering. The ontological and theoretical questions and investigations undertaken in this thesis are therefore questions that consider 'the relation between law and life' (Mackinnon 1989, 237). As DeCoste (1994) argues, a normative stand on the relationship between law, regulation and life must be undertaken, otherwise such research will lack purpose and limit the appearance of questions. I have attempted to set out my normative position in detail in Chapter 4, ultimately adopting a critical and radical position of the regulation of ecological restoration, but also one that still considers and sets out liberal reforms within the current legal tradition.

My normative position and the findings from this thesis would not be as rigorous and grounded without the input, insight and experience of the research participants. The methods set out in Chapters 2 to 4 are grounded in analysing and drawing out findings from the data collected from participants. The thesis adopts an adaptive theory model of research from Layder (2021; 2018), which allows for explicit consideration of social realities and incorporates both theory and empirical data in analysis. This approach is applied in Chapters 2 to 4 and was considered necessary for a thesis dedicated to questions of ideology, ontology and the investigation of social problems. Together, the findings from this thesis demonstrate that a radical (re)orientation of environmental regulation is required for flourishing social and ecological systems. The challenges of birthing 'new worlds' cannot be overstated, but the imperative to do so remains critical.

Finally, this thesis builds on, and contributes to, bourgeoning scholarship from fields such as critical environmental law, ecological law and governance, political ecology and ecological regulatory theory—all of which seek to put forward regulatory responses that challenge dominant neoliberal regimes and re-imagine regulation for social and ecological sustainability and justice (Parker and Haines 2018; Morgan 2015; de Sousa Santos and Rodríguez-Garavito 2005; Garver 2019; Philippopoulos-Mihalopoulos 2011b; Grear and Grant 2015; Osborne et al. 2021). The weaving together of interdisciplinary threads is a large part of this research. It is my hope that this approach has contributed rigorous findings that can support ongoing efforts to effect system change.

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Appendix 1: Explanatory Statement, Participant Consent Form and Covid-19 Participant Information Letter

PARTICIPANT CONSENT FORM

Researcher: Emille Boulot, PhD Candidate
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Project Title: Adaptive Governance in Ecological Restoration

Research Ethics Board file number: 20-02-028

Purpose of the Study

My name is Emille Boulot, PhD candidate of Natural Resource Sciences Department at McGill University, Montreal, Canada. Originally from Australia, I am now undertaking doctoral research on the adaptive governance of social and natural systems. To do this, I am researching ecological restoration practice, policy and regulation across a number of Australian states. As part of my PhD research I am undertaking interviews and observations with experts and stakeholders in ecological restoration projects, such as yourself, to gain a better understanding of the governance processes and institutional arrangements of ecological restoration projects. This includes questions as to the long-term management of ecological restoration projects, the

ability of ecological restoration projects to respond to change, as well as seeking a deeper understanding of ecological restoration science, law, policy and practice.

As a person with significant experience in ecological restoration, rehabilitation and/or environmental governance I believe you have valuable insights and perspectives pertinent to my research. You are invited to take part in this study and I would very much appreciate it if you would agree to be interviewed by me to be a part of this project. Please read this Participant Consent Form in full before deciding whether or not to participate in this research.

Study Procedures: What does the research involve?

Your participation in the project involves being observed and being interviewed. The interview should take up no more than an hour of your time. It involves an audio recorded conversation with myself at a location and time convenient to you. This may be at your office or place of work, a café or could be conducted over Skype or other web based virtual meeting should this be convenient and relevant to you. There is a possibility of a follow-up interview for further discussion should you consent to it. The research material collected from the interview will be de-identified. This means that you will not be referred to by name in the dissemination of the research, only by general role and general location – for example: Ecologist, Queensland, Australia. An interview guide is attached which will give you an idea of the likely topics the interview will cover. For observation, I will be attending the site of ecological restoration that you are involved with and observing the day-to-day practices that occur. I will take written field notes – all observations will not refer to any persons by name, as well as photos. Photos will not be taken of people and photos will not be disseminated with the research if there is the possibility the location could be identified from the photo.

Voluntary Participation

Participation in this research project is voluntary and you may refuse at any time to participate in any aspect of the study. You may decline to answer any question and withdraw from the study at any time for any

reason. Should you choose to withdraw from the project within one month of the interview, your interview material will be destroyed. Following this period, as the data collected is de-identified, withdrawal of your data may not be possible.

Potential risks

There is very low potential level of inconvenience and/or discomfort to you as an interviewee and potential risks are minimal. Your participation in this project is entirely voluntary and you only have to answer those questions to which you wish to respond. If you do consent to participate you can refuse to answer any question if you do not feel comfortable or you may designate certain information 'off the record'. You may withdraw from further participation at any stage.

Potential benefits

Participating in the study might not benefit you or your project or organization directly, but I hope to learn more about the law and governance arrangements of ecological restoration and how adaptive governance may assist ecological restoration projects. Should you be interested in learning further about the results of the research, please let me know and I will be sure to let you know when research is published and disseminated.

Compensation

Participants will not be monetarily compensated.

Confidentiality

The confidentiality of your participation is assured. I will not be referring to any interview participants or observation participants by name or by association to any particular organization in any of the final research products unless express approval is given. Moreover, only I will have access to the interview notes and audio transcripts, which will be stored electronically in a password protected files on the McGill University

server. These recordings and transcripts will not be disseminated. Audio files from our interview/s will be destroyed within 3 years and interview transcripts in 10 years. Written field notes will not refer to participants by name and will be kept on my person or in my office, which is lockable.

Results

The information collected from interviews and observations will be published as academic papers, policy briefs, and conference papers. If you wish to be informed of the research outputs please let me know and I will arrange for you to be contacted as and when research outputs are published.

Questions

If you have any further questions about the study, please contact me or my supervisor. Our contact details are on the front of this Participant Consent Form.

If you have any ethical concerns or complaints about your participation in this study, and want to speak with someone not on the research team, please contact the McGill Ethics Manager at 514-398-6831 or lynda.mcneil@mcgill.ca.

Warm regards,

Emille Boulot

McGill

PARTICIPANT CONSENT FORM

Adaptive Governance in Ecological Restoration

I consent to the following:	**Yes**	**No**
I agree to be interviewed by the researcher	☐	☐
I agree to allow the interview to be audio-taped	☐	☐
I agree to make myself available for a further interview if required	☐	☐
I agree to being observed by the researcher at my place of work	☐	☐

Please sign below if you have read the above information and consent to participate in this study. Agreeing to participate in this study does not waive any of your rights or release the researcher from their responsibilities. A copy of this consent form will be given to you and the researcher will keep a copy.

Participants name (please print):

Participants signature:

Date:

McGill University

Participant Information Letter

COVID-19 and In-Person Research Respecting 2-metre Distancing

(Adaptive Governance in Ecological Restoration 20-02-028)

The health and safety of both research participants and researchers are primary concerns of the University. The purpose of this letter is to provide you with information about COVID-19 and how your study participation may be affected because of COVID-19 related risk. All other information in the study consent remains the same.

Please read the following information to determine if participation is right for you at this time.

The occupational health and safety measures that will be put in place during your study participation have been approved by the McGill Emergency Operations Committee, based on current federal and provincial public health directives as well as recommendations from the World Health Organization (WHO).

What are the risks of COVID-19? For most people, COVID-19 causes mild or moderate symptoms, such as fever and cough. For some, especially older adults and people with existing health problems, it can cause more severe illness, including pneumonia, and, more rarely, may cause death.

Who is most at risk? Persons aged 70 and over, those with a weak immune system and those with a chronic disease such as some cancers, diabetes or heart, lung and kidney disease, are most

at risk of developing serious complications if they contract the virus. As per the Directive: Resumption of research with human participants, in-person research involving these vulnerable populations is not allowed at this time in the absence of a strong clinical imperative.

Can COVID-19 be prevented? Current evidence suggests person-to-person spread of COVID-19 is efficient when there is close contact, making physical distancing an important prevention measure. Proper handwashing, cough hygiene and cleaning with an appropriate disinfectant are also key to limiting virus transmission.

It is important to understand that since study participation may include increased travel outside of your home and increased contact with others within a clinical care environment or research site, it may increase your exposure to COVID-19.

What procedures will be in place to minimize risk of transmission of COVID-19 during your study participation?

The assessments of risks and the protocols to mitigate them are guided by the Directive: Preventing the spread of COVID-19 on campus and the Directive: Principles and procedures for research on campus. Measures that will be taken to reduce the risk include:

- maintaining 2-metre physical distancing;
- hand washing before and after study participation;
- providing the participant with a disposable facemask if they do not have one;
- limiting the number of times a participant has to come to a research site;
- reducing the time participants are in contact with other people;
- ensuring all high-touch surfaces and objects are disinfected daily and disinfected between users.

All research team members are required to have training on preventing the spread of infection and all McGill students and employees must respond each day to a required self-assessment health questionnaire. All participants will be screened before accessing the research site and will be asked

if they have symptoms of COVID-19 or have been in close contact with anyone who has or has had COVID-19. Participation will be cancelled or postponed when responding yes to any of the screening questions. Wearing a mask that covers the mouth and nose is mandatory inside all McGill buildings, in accordance with Quebec public health regulations.

By agreeing to participate in this study you acknowledge that you have been informed of the health and safety procedures in place and agree to follow them. Please be reminded that participation is voluntary and you may decline or postpone participation at any time.

There are two ways to acknowledge receipt of this Participant Information Letter. The first and preferred way is digital confirmation (typically email) in advance of the research taking place. The second, acceptable approach is researcher documentation of verbal agreement.

Appendix 2: Interview Guides

Interview Guide: Restoration practitioners

Scene Setting

- What is your role currently here at X?
- How would you describe your role in the restoration of x project?
- How many organisations/agencies were involved in the planning of the restoration project? How many in the groundwork for the project? How many involved in the long-term management of the project?

The restoration project

- Can you provide a brief description of your project?
- Which organisations, agencies and regulators are involved in the project? Do you have government support?
- Can you briefly describe the relationships between the various parties?
- What are the project's goals and objectives? Why were these objectives chosen?
- How do you measure these goals and objectives?
- Have you been undertaking evaluation of those goals and objectives?
- What do you envision the final outcome of the restoration project to be?
- How long will this project require ongoing management?
- Was there a reference ecosystem for this project? And what was it? How was that decision made?
- What techniques have been used to implement restoration at this site?
- Why were those techniques chosen?
- Were the Society for Ecological Restoration Australasia standards used in this project?
- Do you consider the environment and the non-human in your decision-making? How?
- What is the relationship between the local community/people and this restoration landscape?

Adaptive governance

- How have you managed any setbacks when things haven't been going to plan? Are the setbacks ecological or social?
- Do you have an example of where you had to rethink and respond to an unexpected event or change? And what did you do personally and as an organization to respond to that change?
- How is restoration science included in this project?
- Is there input from local and traditional knowledge?

- How does the local landscape affect your decision making?
- Can you give a brief description of the public and community engagement you have undertaken with this project?
- How is the local community involved? Are they involved?
- Who makes the decisions for this restoration project?
- What is the timescale that decisions are made?
- How is this project financed? For how many years?

Governance frameworks

- What are the guidelines, legal policy or regulation that you must observe for this project?
- Were you consulted in the development of these governance frameworks?
- What are the gaps in the governance framework?
- Are there regulatory barriers to undertaking restoration? What are they?
- Is there the regulatory space for your project to be self-governing and make your own decisions?
- What incentives (monetary or not) were provided for this restoration project?
- Was private property a barrier or conducive to restoration?
- Are the current regulations appropriate?
- Is there space for you to adapt your project after you've been granted an environmental permit?

Opportunities and challenges for reform

- What are the biggest challenges you face in your work?
- What opportunities exist to resolve these challenges?
- What incentives are needed for ecological restoration?
- Is adaptive governance for ecological restoration appropriate? What is missing? Is there an alternative governance framework you prefer? What opportunities exist to institute it at the local/state/national level?

Evaluation

- Do you consider current governance arrangements to be adequate in ecological restoration governance?
- To what extent is ecological restoration regulation formal or informal?
- Is there integration of restoration regulation from the local to the national and across the various different departments within government agencies?
- Do you face political challenges with your project?
- Do you have capacity/capability to meet social and ecological challenges?

Reflection

- How would you redesign ecological restoration regulation if you had the opportunity and resources to do so?

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Interview Guide: Legal and governance experts

Scene Setting

- What is your role currently here at X?
- How are you involved in ecological restoration regulation?
- How many organisations/agencies are involved in the regulation of ecological restoration here at X? (if applicable)

Ecological restoration governance

- What are the guidelines and legal policy for ecological restoration? Are the SER standards included?
- Is regulation sector specific? Can you give an example?
- What are the gaps in the regulation?
- Are there regulatory barriers to undertaking restoration? What are they?
- Is there the regulatory space projects to be self-governing and make their own decisions?
- Is private property a barrier or conducive to restoration?
- Are the current regulations appropriate? Why or why not?
- Is there space for adaptation of the project after an environmental permit has been granted?
- How is restoration science included in the regulations?
- Is there input from local and traditional knowledge?
- Are there requirements for public and community engagement?
- How is the landscape/non-human conceived of in the regulation process?
- What are the timescales that decisions are made?
- How are projects predominantly financed? For how many years? By whom?
- What incentives are provided to undertake restoration?
- Is there opportunity for ongoing monitoring and evaluation of projects in the regulation?
- Is adaptive governance and adaptive management occurring in ecological restoration regulation? Are the rules reflexive?
- Is authority for decision-making spread across a number of organisations, agencies and communities? How is the decision-making coordinated?

Opportunities and challenges for reform

- What are the biggest challenges you face in your work?
- What opportunities exist to resolve these challenges?
- Is adaptive and reflexive regulation for ecological restoration appropriate? What is missing? Is there an alternative governance framework you prefer? What opportunities exist for its inclusion at the local/state/national level?
- What incentives are needed for ecological restoration?

Evaluation

- Do you consider current governance arrangements to be adequate in ecological restoration governance?
- To what extent is ecological restoration regulation formal or informal?
- Is there integration of restoration regulation from the local to the national and across the various different departments within government agencies?

Reflection

- How would you redesign ecological restoration regulation if you had the opportunity and resources to do so?

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Interview Guide: Community members

Scene Setting

- How are you involved with project X?
- How long have you been involved?
- How would you describe your role here at X?
- How did you become involved with this project? Why do you stay involved?
- How many organisations/agencies are involved in ecological restoration here at X?

Ecological restoration

- Can you provide a brief description of your project?
- What are the project's goals and objectives?
- Have you been involved in setting the goals and the objectives? How did you decide those objectives?
- How do you incorporate the interest of the landscape and the non-human in decision-making/objectives?
- Have you been undertaking evaluation of those goals and objectives?
- What do you envision the final outcome of the restoration project to be?
- How long will this project require ongoing management?
- Is the community engaged with this project?
- Was there stakeholder and community engagement?
- Has local knowledge been included in the restoration of this site?
- What is your relationship to this particular landscape?
- Has the landscape been significantly improved? How?
- Was the project a financial burden for the community or did it create financial opportunities?
- How has the project impacted the local community?

Ecological restoration governance

- How are decisions made? Is the community involved? Are there opportunities for the community to be involved?
- Are there regulatory requirements to include the local community?
- Are private property concerns an issue for this project?
- What are the timescales that decisions are made?
- Does the community finance the project? If so for how many years?

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Interview Guide: Ecologists and technical advisers

Scene Setting

- What is your role here at X?
- How would you describe your general role in the restoration of degraded areas?
- Are you involved in the planning of restoration projects? The groundwork for projects? Are you involved in the long-term management of projects?

The restoration project

- How do you identify goals and objectives for restoration projects? How do you incorporate ecological interests in goal and objective setting? What do you think are ecological interests?
- How do you measure those goals and objectives?
- Are those goals and objectives subject to ongoing evaluation?
- Do you identify reference ecosystems and how?
- What techniques are used in the restoration of XX?
- Are the Society for Ecological Restoration standards applicable to your work?

Governance

- How have you managed any setbacks when things haven't been going to plan? What are common ecological and social setbacks?
- Do you have an example of where you had to rethink and respond to an unexpected event or change?
- How is restoration science included in this project? Do you plan restoration taking a holistic perspective of the overall system? Or are you guided more by standards for water, soil, air quality etc.?
- How necessary is public and community engagement for restoration projects? What are the benefits/challenges of community involvement?
- At what timescale do you suggest decision-making for restoration occur?
- What are the general guidelines and legal policy that you must observe for restoration?
- Were you consulted in the development of these guidelines?
- What are the gaps in the regulation?
- Are there regulatory barriers to undertaking restoration? What are they?
- Is private property a barrier to restoration?
- Is there space for adaptative governance/management to occur in ecological restoration?

Opportunities and challenges

- What are the biggest challenges you face in your work?
- What opportunities exist to resolve these challenges?

- Is adaptive regulation for ecological restoration appropriate? What opportunities exist to institute that at the local/state/national level?
- What measures could facilitate adaptive governance in ecological restoration? What incentives could be provided?
- Do you consider current governance arrangements to be adequate in ecological restoration governance?
- What is best practice regulation for ecological restoration?

Reflection

- How would you redesign ecological restoration regulation if you had the opportunity and resources to do so?

Appendix 3: Codebook for Chapter 2

Name of Code	Files	References
Iterative learning	1	1
Adaptation - changing social and ecological conditions	2	3
Adaptive capacity	1	1
Adaptive management	14	25
Adaptive management - explicit aim	3	6
Adaptive regulation - planning tools	2	4
Evidence based decision making	1	1
Forest practice system - research and science	6	26
Information management	9	20
Information provision	4	7
Management - review	2	2
Management costs	3	6
Management plan - monitoring and evaluation	4	5
Monitoring	17	42
On the ground monitoring	1	3
Industry standards - monitoring and evaluation	1	1
Monitoring - ineffective	2	3
Monitoring and maintenance funding	4	7
Monitoring informing management	6	15
Monitoring of systems	8	17
Qualitative monitoring	1	1
Remote sensing monitoring	1	3
Multi-disciplinary research	4	8
Peer-to-peer communication	4	4
Research to policy	3	12
Restoration - experimentation	1	1
Multi-scalar institutions	0	0
Cross-sector communication	5	12
Federal influence on restoration	5	6
Federal intervention in environmental management	7	16
Institutional level governance and planning	2	2
Planning - constraints	3	5

Name of Code	Files	References
International regulatory influence	6	7
Intragovernmental policy development	5	13
Intragovernmental transfer - personnel	1	1
Local government planning	3	4
Local planning - politics	1	1
Multi-level governance	5	7
Multi-organization involvement	8	12
Regionality	0	0
Reporting - challenges	1	2
Umbrella regulatory systems	1	1
Regulatory accountability through standards	1	1
Accountability	16	42
Enforcement of standards - politics	3	3
Transparency	5	7
Barriers	0	0
Administrative burden	2	5
Regulator- capacity	6	17
Availability of expertise	1	2
Regulator - culture	3	3
Regulator capture	5	8
Capacity to regulate	2	2
Industry determined involvement	3	6
Industry determining compliance	3	6
Industry led reform	3	7
Regulatory system failure	5	10
Standards – non-mandatory	3	5
Co-regulation	3	10
Co-regulation - carrot and stick	3	6
Co-regulation - non-compliance	4	8
Compliance	3	5
Enforcement	5	9
Exemptions for specific industries	2	2
Forest Practices System - regulation	8	28
Forest policy development	5	8

Name of Code	Files	References
Forest Practice Code - operation	8	18
Forest Practice Code - review	3	5
Forest practice plan - operation	4	12
Forest Practice Plan - auditing	3	5
Forest practices plan - requirements	4	9
Forest practice regulation and industry certification	7	13
Forest Practice System - assessment	2	3
Forest practice system - biodiversity management	4	18
Forest practice system - threatened species management	6	22
Forest practice system - climate change	2	3
Forest practice system - conflict of interests	6	8
Forest Practices System - appeals	2	2
Forestry - standards	3	4
Forestry rehabilitation bond	2	3
Government evaluation and oversight	6	9
Increasing complexity in land management	6	16
Independent regulation	6	9
Independent oversight	11	22
Independent regulation - mining	1	4
Independent authorities	5	11
Independent oversight - benefits	4	6
Independent regulation - politics	5	12
Mining	1	1
Regulatory process- mining	5	23
Quarry regulation	1	2
Regulation burden	4	7
Regulation keeping up with practice	2	2
Regulator - role	6	18
Relationship of regulator and regulated	1	1
Regulatory ambit	2	3
Regulatory influence on restoration	3	4
Regulatory oversight - Federal and state engagement	8	25
Restoration - standards across landscape	5	8
Standards - poor standards	7	21

Name of Code	Files	References
Standards - SER	6	11
Values tradeoff	2	2
Balancing social, environmental, economic values	15	24
Values - conflict	7	9
Stakeholder engagement and participation	0	0
Education	10	16
Equity in land management	0	0
Age equity	1	1
Forestry - social elements	5	8
Forestry - economic viability	5	9
Forestry - employment	2	5
Forestry - outreach	2	2
Social license to operate	13	26
Concern of not doing 'the right thing'	1	1
Relationship (trust) building	12	35
Social equity	1	2
Social license - smaller operators	1	1
Stakeholder management	9	15

Appendix 4 : Codebook for Chapter 3

Name of Code	Files	References
Case studies	0	0
Forest restoration	2	3
Forest estate - shrinking	3	4
Forest practice system -values	3	7
Forestry - ethos	6	12
Forestry - renewable resource	5	7
Forest Practices Authority - operation	3	33
Forest Practices Authority - establishment	3	3
Forestry - education and training	4	7
Forestry - harvesting	1	1
Forest products	0	0
Biomass energy	1	1
Forestry - sustainable yield	2	4
Forestry - NGO politics	3	3
Forestry - restoration	8	32
Forestry Tasmania - forest management	1	1
Native forest - plantation mix	2	3
Native forest estate - private	2	4
Plantation Forests Tasmania - operation	4	6
Plantation - failure	2	5
Plantation - restoration	4	5
Plantation estate - shrinking	2	3
Plantation forest - harvesting	2	3
Plantation forest - influences	3	5
Tree planting financial return - temporal elements	2	3
Private Forests Tasmania	1	2
Private forest - economics of production	2	3
Private forest - investment impetus	1	3
Private forests - business model	1	2
Private forest - estate productivity	1	1
Private forest - management and operation	1	1
Private forest - risk distribution	1	1

Name of Code	Files	References
Private forest estate - market share	2	4
Private Forests Tas - structure and governance	1	3
Private timber reserve	1	4
Public private forestry operations - land management	4	9
Wood volume targets - regulatory influence	3	6
Landscape restoration	9	27
Agricultural practice	5	15
Multigenerational management	6	12
Mine rehabilitation and closure	6	26
Degen novel ecosystems - regulatory limbo gap	2	2
Mine closure costing	2	3
Mine completion criteria	1	3
Mine rehabilitation bond	3	6
Mine rehabilitation monitoring	2	8
Mining - Indigenous people	2	13
Mining - post closure land use	3	5
Mining - Tasmania	1	1
Mining conflict	1	2
Progressive mine rehabilitation	3	10
Community participation	0	0
Building social consensus	10	15
Collaboration	3	5
Communication - communities	8	16
Community capacity	5	17
community engagement	19	49
Community oversight	8	13
Impacts - local people	2	6
Indigenous engagement	11	35
Free prior informed consent	1	4
Indigenous land management	3	15
Indigenous co-management	3	5
Indigenous land management - issues	1	1
Access to country	1	2
CDP reform	1	1

Name of Code	Files	References
Indigenous led land management	2	3
Indigenous opportunities	1	9
Local knowledge	5	13
Local practice	2	2
Local people - restoration	0	0
Local champions	5	9
Local community leadership	4	10
Multi-stakeholder involvement	6	8
Regulation - social elements	3	6
Restoration - local community - social and economic	17	55
Role of community	10	22
Social and ecological systems	6	12
Social ecology - social sciences	3	6
Transdisciplinary scholarship	1	1
Environmental statehood	7	14
Influence of industry	9	21
Industry funding	5	6
Influence on government	2	7
Market led restoration	2	2
Biodiversity market	4	5
Biodiversity -offsets	5	8
Biodiversity vs-& climate change	3	7
Carbon market	1	1
Carbon market - advocacy	4	4
Carbon market - biodiversity co-benefit	2	2
Carbon market - income	6	10
Carbon market - influence	11	27
Carbon market - plantation timber	5	6
Carbon market - regulation	3	5
Commodification of socio-ecological systems	3	3
Economic value	1	1
Commons - non-excludability	1	2
Production (market) (development) externalities	2	3
Ecosystem services	6	6

Name of Code	Files	References
Funding - offsets	3	3
Human nature relationship	6	10
Anthropocentric view	1	3
Market based tools	5	7
Market failure - restoration	1	10
Market influence - private forest estate	1	3
Market influence on land management	9	12
Market influence on standards	6	16
Market opportunities	10	16
Market orientation - Greening Australia case study	2	4
Market proximity	1	3
Market regulation	1	2
Market valuation	1	12
Markets - industry certification	8	17
Natural capital accounting	2	2
Public - private restoration	7	19
Public - private conflict	4	11
Public - private funding	7	19
Restoration - offsets	3	7
Offset - regulation	2	6
Restoration economy	1	1
Restoration market	2	4
Neoliberalism - influence	6	10
Growth paradigm influence	1	3
Institutional roles	0	0
Individual - role	0	0
Advocacy - personal	2	4
Invested personnel	6	7
Leadership	2	2
Personal investment	6	18
Personnel - experience and training	2	4
Restoration - NGO delivery	4	8
Landcare concerns	3	7
Landcare funding	1	1

Name of Code	Files	References
NGO funding	9	15
NGO - funding management	5	7
NGO issues	3	6
Restoration - initiative from NGO sector	7	10
Role of the NGO sector	6	11
Role of research	12	22
Applied research	5	9
Basic research	2	2
Funding - research	7	14
Research sophistication	4	7
Value - science	2	6
Western Science	1	2
Science-policy-practice interface	13	29
Science - influence	9	15
Science - support from government	2	2
Science advocacy	2	4
Science communication	2	6
Science influence on regulation	7	8
Role of the state	4	6
Lack of political continuity or commitment	2	3
Public led restoration	0	0
Public good - restoration	9	21
Restoration - role of government	6	11
Role of government - state	5	7
Role of law in land governance	5	5
Role of university	2	3
Funding - community engagement	1	1
University influence	5	8
Regulatory reform	9	15
Advocacy by organisation	4	6
Legislation design	1	2
Restoration - culture	4	8
Connection to land - place	8	23
Aesthetic - landscape	1	1

Name of Code	Files	References
Family farm	7	10
Restoration - case for	4	9
Restoration benefits - human health	2	3
Restorative environmentalism	2	2
Restoration - definition, objectives, method	2	7
Connectivity	9	31
cultural heritage management	6	12
Diversity - social and ecological systems	2	3
Ecosystem trajectory	1	2
Landscape function	1	5
Pest management	2	2
Resilience to disturbance	3	5
Restoration - definition	4	4
Restoration - degraded landscapes	11	14
Restoration - Invasive species	2	4
Restoration methods	0	0
Disturbance related systems	2	2
Eucalypt regeneration	1	1
Passive restoration	1	1
Restoration assumptions	1	1
Restoration for fauna	5	13
Restoration method - burning and reseeding	3	5
Restoration method - shelterbelt and tree planting	5	18
Tree planting operation	9	13
Tree planting - failure	8	23
Tree planting - market pull factor	6	7
tropical restoration	1	3
Wetland restoration	1	1
Self-sustaining ecosystem	3	3
Threatened species management	10	17
Threatened Species Act (Tas)	3	4
Threatened species regulation	6	9
Restoration - drivers and constraints	0	0
Climate change - influence	8	11

Name of Code	Files	References
Climate adaptation	6	16
Restoration - genetic research	3	7
Future existential threats	4	6
Poor environmental outcomes	1	2
Perverse environmental outcomes	8	13
Offshore environmental transfer	2	2
Restoration - economics	0	0
Downstream processing	1	3
Economic incentives	8	14
Economic incentives - indirect	3	3
Economic resilience	3	3
Diversity for economic resilience	8	13
Economics of scale	4	11
Forest management - umbrella schemes	1	2
Funding	0	0
Funding - barriers	4	9
Funding - inadequate	11	21
Funding - ineffective	1	1
Funding - political cycles	7	17
Funding - up front	4	7
Capital costs	2	3
Funding issues - ad hoc	10	25
Funding issues - reliability	8	19
Short term funding	4	5
Funding - performance based	4	9
Funding processes	9	14
Government funding	18	51
Ongoing annual funding	6	14
Philanthropic funding	8	18
Private philanthropy - influence	7	15
Restoration - economic constraints	6	8
Restoration - employment	3	4
Restoration - return on investment	2	2
Restoration - riparian zones	4	7

Name of Code	Files	References
Restoration achieving recovery	10	17
Recovery - planning	4	7
Identifying areas for restoration	1	3
Reference ecosystems	7	19
Rehabilitation - residual risk	1	1
Restoration - Novel ecosystem	7	9
Shifting ecological baselines	2	3
Restoration - enablers	0	0
Market based initiatives	2	2
Restoration driver - certfication	2	2
Resourcing	0	0
Restoration - long term management	20	61
Restoration success - continuity of personnel	5	7
Restoration - marginal land	2	3
Restoration - Nudging	1	1
Restoration - limitations to effective recovery	8	18
Removing disincentives to restoration	1	1
Restoration - delivery constraints	6	7
Seedbank collection	5	16
Seed availability	6	10
Restoration - failure	7	16
Restoration - priority	3	3
Root cause - land degradation interventions	0	0
Restoration driver - class 4 streams	2	3
Restoration driver - farm viability	6	14
Restoration driver - payment for services	4	7
Restoration driver - respect and recognition	1	1
Restoration driver - threatened species	4	5
Restoration drivers - research	9	30
Risk management	2	6
Restoration uptake - risk	3	6
risk allocation - end land users	1	1
State liability	3	9
Restoration - legacy concerns	5	8

Name of Code	Files	References
Water quality - issues	2	6
Restoration - spatial considerations	0	0
Place based governance approaches	8	14
Biodiversity Conservation	9	23
Biodiversity - value	2	6
Biodiversity metrics	8	12
Commons - loss	1	1
Conservation - enclosure	2	3
Conservation - restoration relationship	6	14
Conservation theory	5	6
Conservation-preservation	10	18
Effective land use planning	3	4
Bioregionalism	1	4
Catchment management	3	3
Context or socioecological system specific	6	11
Land management - integration	3	4
Landscape level - management	10	18
Landscape level - planning	8	15
Planning - integration	4	5
Planning - strategic	7	18
Planning drivers	4	5
Regional economies	2	2
Regional perspectives	1	1
Regional planning	1	2
Local economies	0	0
Local markets	2	3
Local supply chains	2	2
Productive landscapes	17	32
Land sharing - active management	12	28
Land use - conflicting uses	5	5
Land clearing - practice	9	17
Land clearing - regulatory gap	8	17
Productive vs reserve systems	8	16
Tenure and restoration	7	10

Name of Code	Files	References
Covenants - environmental management	4	14
Stewardship	7	15
Stewardship vs Covenants	4	10
Land tenure - security	4	4
Land tenure categories	4	5
Private property - influence on environmental management	13	43
Private property - limitations	10	18
Public land - conservation management	4	8
Remote ownership - global corporations	2	2
Remote management - mining	1	1
Tenure blind	5	10
Restoration - landscape level	8	10
Restoration - scale	6	15
Restoration - temporal elements	2	5
Long term funding	17	52
Long term involvement	11	18
Long term management - challenges	9	18
Long term management - mining	6	11
Long term management vs short term politics	9	15
Long term planning	4	10
Long term tenure	3	3
Long term vision	2	3
Long-term investment	8	10
Long-term management - farming	9	23
Long-term management - forestry	9	22
Succession	8	19
Knowledge transfer - project	1	4
Temporalities of socio-eco-legal systems	0	0
Ecosystem timescales	4	6
Short timeframe constraints	4	6
Temporal perspectives	1	1
Temporal limitations of regulation	5	5
Standards - enabling regulation	0	0
Measuring recovery success - metrics	10	27

Name of Code	Files	References
Measuring ecosystem function	5	12
Metrics -development	6	15
Regulation - enabler	2	5
Standards - for better outcomes	4	6
High level standards	3	5
Standards - achievable	2	4
Standards - specificity	8	12
Regulation - place or context specific	2	3
Strong standards	9	14
Values in restoration	0	0
Multi-value management	6	10
Non-economic value - restoration	6	11
Restoration - non-commensurable value	3	4
Value - complexity	5	7
Value - ecology	4	4
Values - community	5	10
Values - environment	9	11
Values - planning	5	6
Values - wilderness	2	2

Appendix 5: Detailed summary of the multi-level institutional analysis across the three case study sites

Table 6: Multi-level institutional analysis of mine rehabilitation and closure, Queensland

Agency	Federal Government	Department of Resources	Department of Environment and Science	Department of State Development, Infrastructure, Local Government and Planning	Office of the Queensland Mine Rehabilitation Commissioner	Industry	Local communities	Research bodies	Industry and market certification bodies.
Key regulation	*Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act); *Native Title Act 1993* (Cth); Native Title (Indigenous Land Use Agreements) Regulations 1999; Leading Practice Sustainable Development Program for the Mining Industry: Mine Closure 2016; Leading Practice Sustainable Development Program for	*Mineral Resources Act 1989* (Qld); Mineral Resources Regulation 2013 (Qld); *Mineral and Energy Resources (Common Provisions) Act 2014* (Qld); *Mineral and Energy Resources (Financial Provisioning) Act 2018* (Qld); *Petroleum Act 1923* (Qld); *Petroleum and Gas (Production and Safety) Act 2004* (Qld); *Vegetation Management*	*Environmental Protection Act 1994* (Qld); Environmental Protection Regulation 2008; Environmental Impact Statement Process for Resource Projects Guideline 2015; Financial Assurance under the *Environmental Protection Act 1994* Guideline 2016; Triggers for Environmental Impact Statements under the *Environmental Protection Act*	*State Development and Public Works Act 1971* (Qld); *Strong and Sustainable Resource Communities Act 2017* (Qld); Preparing an Environmental Impact Statement: Guideline for Proponents 2015; Social Impact Assessment Guideline 2018.	Appointed under *Environmental Protection Act 1994* (Qld) Chapter 8A with functions set out in s 444I.	Subject to the *Mineral Resources Act 1989* (Qld); *Environmental Protection Act 1994* (Qld); *Strong and Sustainable Resource Communities Act 2017* (Qld); *Mineral and Energy Resources (Financial Provisioning) Act 2018* (Qld); Mined Land Rehabilitation Policy.	*Strong and Sustainable Resource Communities Act 2017* (Qld); *Native Title Act 1993* (Cth).	The relevant terms and rules of public and private funding arrangements.	MCA Enduring Value Framework 2015; ICMM 10 Principles of Sustainable Development 2003; Sustainability standards and certification programs (for e.g. Towards Sustainable Mining® and Aluminium Stewardship Initiative).

	the Mining Industry: Mine Rehabilitation 2016.	*Act 1999* (Qld); Environmental Protection (Rehabilitation Reform) Amendment Regulation 2019; Mined Land Rehabilitation Policy.	*1994* for Mining and Petroleum Activities 2014.						
Key responsibilities	Overseeing the operation of the EPBC Act especially matters of national environmental significance; Developing Native Title policy and regulation; Developing best practice guidelines for MR&C.	Mineral resource policy development; Planning, monitoring, implementation and review of mineral resource regulation; Responding to non-compliance.	Issues environmental authorities for environmentally relevant activities including mining activities; Assesses PRCPs; Issues mine closure certificates.	Coordinator-General oversees the Strong and Sustainable Resource Communities initiative; Develop guidelines and policy regarding social impact; Implements and reviews the *Strong and Sustainable Resource Communities Act 2017.*	Engages with stakeholders and the community to raise awareness of mine rehabilitation matters; Produces technical reports on the best practice rehabilitation of land impacted by resource activities; Provides advice to the Minister on mine rehabilitation practices, outcomes and policies; Reports on mine rehabilitation performance and trends in Queensland.	To meet their responsibilities under the relevant MR&C regulation; fulfil their responsibilities to shareholders.	Stakeholders in mining development and MR&C. Local communities may also be rights holders under the *Native Title Act*.	Undertake research to support the technological capacity of MR&C; develop best practice MR&C indicators; engage and amplify the knowledge and voices of local communities.	Develop best practice guidelines for MR&C; Accredit and oversee certification processes; disseminate MR&C guidelines and industry guidelines; Advocate on behalf of industry.
Drivers	Limiting state liability and	Limiting state liability and	Limiting state liability and	Increasing the social and	Undertaking reviews of	Ensuring ongoing access	Ensuring MR&C is	Increasing the technological	Maintain social licence

	responsibility for MR&C; Management of matters of national environmental significance; Ensuring a robust mining industry as contributor to GDP; Ensuring social licence for mining.	responsibility for MR&C; Facilitating a robust mining industry which contributes to the state's budget and employment; Ensuring social licence for mining remains current.	responsibility for MR&C; Manage environmental impacts for human and ecological health.	economic benefits for local communities.	MR&C practices and reporting to government; Limiting state liability for MR&C.	to resources; Lowering production costs where relevant; Maintaining social licence.	undertaken to allow for post-mine land use; accountability; ensuring benefit sharing in mining; ensuring ongoing employment opportunities.	capacity of MR&C; Developing metrics for regulatory accountability; Researching local communities and assisting with research to support local community MR&C agendas.	to operate; develop best practice for MR&C.
Effect on socio-ecological recovery	Ineffective.	Ineffective.	Moderately effective.	Unclear.	Unclear.	Ineffective.	Moderately effective.	Moderately effective.	Moderately effective.

Table 7: Multi-level institutional analysis of forest restoration, Tasmania

Institution	Department of State Growth	Department of Natural Resources and Environment	Forest Practices Authority	Sustainable Timber Tasmania	Private Forests Tasmania	Industry	eNGOs
Key regulation	*Forestry (Rebuilding the Forest Industry) Act 2014* (Tas); Permanent Native Forest Estate Policy; Tasmanian Regional Forest Agreement.	*Nature Conservation Act 2002* (Tas); *National Parks and Reserves Management Act 2002* (Tas); *Crown Lands Act 1976* (Tas); *Threatened Species Protection Act 1995* (Tas); *Historic Cultural Heritage Act 1995* (Tas); *Aboriginal*	*Forest Practices Act 1985* (Tas); Forest Practices Regulations 2017 (Tas); Forest Practices Code; *Threatened Species Protection Act 1995* (Tas); *Nature Conservation Act 2002* (Tas);	*Forest Management Act 1985* (Tas); *Forest Management Act 2013* (Tas); *Forestry (Rebuilding the Forest Industry) Act 2014* (Tas); Forest Management Act Ministerial Charter –	*Private Forests Act 1994* (Tas); Forest Practices Code.	*Tasmanian Forest Agreement Act 2013* (Tas); *Forestry (Rebuilding the Forest Industry) Act 2014* (Tas).	*Tasmanian Forest Agreement Act 2013* (Tas); Forest Practices Code.

		Heritage Act 1975 (Tas)*; Environment Management and Pollution Control Act 1994* (Tas)*; Biosecurity Act 2019* (Tas)*;* Tasmanian Reserve Management Code of Practice.	Tasmanian Regional Forest Agreement; Permanent Native Forest Estate Policy.	Forestry Tasmania 2015.			
Key responsibilities	Policy development; Monitoring, implementation and review of the Regional Forest Agreement.	Collect information on Tasmania's natural and cultural values; Provide advice on the location and the management of these values; Manage formal reserves, crown land, and 'Future Potential Production Forest' land in line with the Tasmanian Reserve Management Code of Practice.	Implement and regulate the forest practices system by: publishing the Forest Practices Code; issuing forest practice guidelines and forest practice plans; preparing State of the Forests Report every five years; administering Private Timber Reserves.	Manage the Permanent Timber Production zone land by: planning and monitoring to ensure a sustained wood yield to meet minimum legislated supply; planning, implementing and monitoring wood products supply; sustainably manage non-wood values.	Facilitate and expand the development of the Tasmanian private forest resource.	Undertake reforestation and forest restoration in line with Forest Practice Plans.	Stakeholder in Tasmanian forest space; Occasionally undertake forest restoration in line with the Forest Practices Code.
Drivers	Ensure ongoing timber production; Uphold the RFA agreement with focus on economic, social and environmental outcomes; Facilitate the growth of the forest industry.	Manage natural and cultural values; manage and undertake restoration on crown land, reserves and Future Potential Production Forest; Oversee threatened species management.	Oversee the forest practices system including forest restoration.	Ensure sustained wood yield to meet minimum legislated supply; Meet their environmental obligations under legislation.	Maintaining the plantation estate; Increasing the viability of agroforestry.	Ensure supply of timber for the Tasmanian forest industry; Maintain social licence; Meet requirements for market-based certification programs.	Advocate for conservation for forests including an end to native forest logging; Undertake restoration; Advocate for increased restoration standards.
Effect on socio-ecological recovery	Moderately effective.	Moderately effective.	Moderately effective - effective.	Moderately effective.	Ineffective.	Moderately effective.	Moderately effective – effective.

Table 8: Multi-level institutional analysis of landscape restoration, Australia Wide

Agency	Federal government	State government	Local government	NGO/Landcare/Regional NRM groups	Research institutions	Private funding institutions	Private landholders
Key regulation	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)*; National Greenhouse and Energy Reporting Act 2007* (Cth)*; Carbon Credits (Carbon Farming Initiative) Act 2011* (Cth)*; Natural Resources Management (Financial Assistance) Act 1992* (Cth); National Landcare Program; Commonwealth Grants Rules and Guidelines 2017; Australia's Strategy for Nature 2019-2030; Environmental Restoration Fund.	Framework regulation for land use planning (see for e.g. the *Land Use Planning and Approvals Act 1993* (Tas)); Regulation for the management of conservation covenants (see for e.g. the *Nature Conservation Act 1992* (Qld) s. 45); Environmental and biodiversity offset regulation (see for e.g. the *Biodiversity Conservation Act 2016* (NSW)).	Local planning laws	*Australian Charities and Not-for-profits Commission Act 2012* (Cth); *Charities Act 2013* (Cth); *National Landcare Program* *Natural Resources Management (Financial Assistance) Act 1992* (Cth).	The relevant terms and rules of public and private funding arrangements.	Conservation covenants – each state and territory has approved covenanting programs by the Environment Minister for the purposes of the *Income Tax Assessment Act 1997* (Cth).	Conservation covenant programs; land use planning laws; carbon accounting legislation.
Key responsibilities	Manage matters of national environmental significance; Oversee the development and regulation of the national carbon credit market; Provide funding for natural resource management; Oversee the National Reserve System.	Manage formal reserves and crown land; Develop framework regulation for land use planning and set planning policies; Manage conservation covenants; Oversee environmental and biodiversity offset schemes; Undertake rehabilitation of degraded crown land following development; Establish funding	Oversee local planning and development; Manage local reserves.	Meet statutory requirements under relevant regulation; undertake restoration activities in line with funding arrangements and NGO mandate.	Undertake research to support the technological, social and ecological capacity of landscape restoration; develop best practice restoration indicators; engage and amplify the knowledge and	Meet tax and funding requirements under relevant regulation.	Meet tax and land use requirements under relevant regulation.

		avenues for NRM and Landcare bodies.			voices of local communities; undertake monitoring and evaluation.		
Drivers	Oversee the development and regulation of the national carbon credit market; meet community expectations regarding environmental management and funding.	Facilitate (sustainable) land development; limit state liability for land degradation; meet community expectations for conservation.	Facilitate land development; limit liability for land degradation; maintain local reserves.	Funding for restoration; access to private property; community engagement and participation.	Research funding; local community, industry and organisational linkages; researcher interest.	Carbon market trading; social licence concerns.	Philanthropy; Carbon credits; Social licence concerns; Shade and shelter for agricultural landholders; Funding for land management through conservation initiatives; Personal interest in conservation or restoration management.
Institutional and instrumental effect on recovery	Moderately effective.	Moderately effective.	Moderately effective to ineffective.	Moderately effective to effective.	Moderately effective to effective.	Moderately effective.	Moderately effective to effective.