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Upscaling marine and coastal restoration through legal and governance solutions: Lessons from global bright spots

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ABSTRACT

There is a global imperative to upscale restoration in line with the Kunming-Montreal Global Biodiversity Framework. Upscaling of marine and coastal restoration is hindered by legal and governance barriers. Identifying both the types of barriers and potential solutions from global 'bright spots' is a first step toward implementing legal and governance frameworks to facilitate upscaling of marine and coastal restoration. Here we identify five types of barriers including (a) lack of fit-for-purpose permitting frameworks, (b) tenure issues, (c) concerns regarding risk and liability, (d) a lack of overarching targets for restoration, and (e) uncoordinated governance frameworks. For each barrier, we conduct a broad analysis of legal and governance solutions from across the world. Our analysis provides a guide for future research and law and governance reform.

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1. Introduction

The Kunming-Montreal Global Biodiversity Framework (GBF) heralded a new level of ambition for ecosystem restoration. Building on the momentum generated by the declaration of the UN Decade on Restoration (United Nations, 2019), Target 2 of the GBF (the '30 % restoration target') requires signatories to 'ensure that by 2030 at least 30 percent of areas of degraded terrestrial, inland water, and marine and coastal ecosystems are under effective restoration, in order to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity' (Convention on Biological Diversity, 2022).

The target leaves some scope for legal and ecological interpretation: for example, what is considered a 'degraded' ecosystem, what meets the threshold of 'under effective' restoration, and critically, whether the 30 per cent target must be achieved uniformly across all areas (i.e. terrestrial, inland water, and marine and coastal), and all ecosystem types (Bell-James et al., 2024a). Despite this uncertainty in legal formulation, the intention of the GBF is for countries to invest in transformative change (Convention on Biological Diversity, 2022). If Target 2 is interpreted in the spirit of such transformative change, a high level of progress and action will be needed to meet this target (Hughes, 2023; Obura et al., 2021; Pörtner et al., 2023).

One risk in interpretation of the GBF target is that countries focus their domestic restoration efforts on terrestrial environments at the

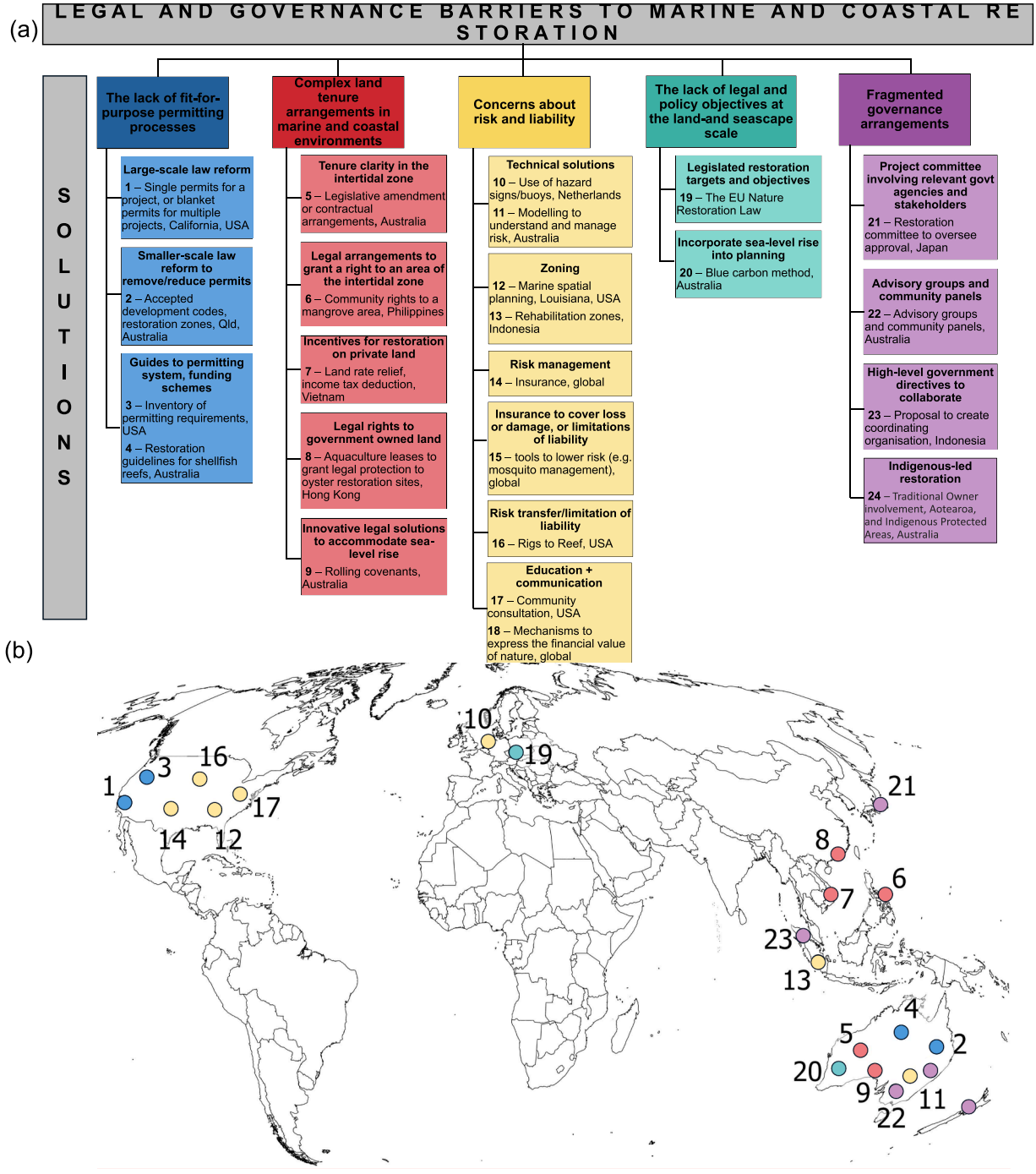

Fig. 1. Legal and governance barriers to marine and coastal restoration and example solutions from across the globe. (a) is a list of the example solutions coded by barrier, and (b) shows the geographic spread of countries considered.

expense of marine and coastal environments. Restoration research and practice in the marine realm has lagged behind the terrestrial realm (Bekkby et al., 2020; Saunders et al., 2020), and marine and coastal restoration techniques have often been more difficult and expensive than their terrestrial counterparts (Bayraktarov et al., 2016). More recently, research has highlighted how legal and governance frameworks – even those designed for environmental protection – exacerbate the cost and difficulty of marine and coastal restoration (Razak et al., 2022; Saunders et al., 2022, 2024a) and present a barrier to scaling-up (Grenier et al., 2021; Craton, 2022; Shumway et al., 2021) and appropriate site choice (Bell-James et al., 2023a). A recent survey of the Australian coastal restoration community revealed that regulatory frameworks are, along with a scarcity of funding, the biggest barrier to marine and coastal restoration (Saunders et al., 2022). A further empirical study showed instances of restoration proponents downscaling the scope of their projects due to the complexity of permitting frameworks (Bell-James et al., 2023a). This will impair the delivery of the crucial ecosystem services discussed above, and is at odds with the GBF's call to scale-up restoration action.

However research has also highlighted coastal and marine restoration 'bright spots': highly successful projects that can reveal important lessons and help with the rapid scaling-up of restoration (Saunders et al., 2020). Learning from bright spots is an approach which has been used in diverse fields, from ecology to human health. In emerging areas of research and practice, failures may be common or even expected, therefore, looking to the status quo or median outcomes, while important, does not provide the most forward looking approach. The bright spots approach acknowledges that identifying and learning from highly successful examples from research or practice is important for generating inspiration, driving innovation, and ultimately to overcoming barriers (Koss et al., 2015). Learning from these success stories is critical because coastal restoration can improve essential ecosystem services, such as blue carbon storage, adaptation to climate change (Waltham et al., 2020), increased fisheries resources, improved water quality, and protection from coastal inundation (Hagger et al., 2022).

The objective of this paper is to apply this 'bright spots' lens in the legal and governance context, and highlight examples of legal and governance solutions to marine and coastal restoration, as a guide for further legal and policy developments across the globe (Fig. 1). While pervasive legal and governance barriers have been chronicled in the literature (see e.g. Grenier et al., 2021; Craton, 2022; Shumway et al., 2021; Saunders et al., 2022; Bell-James et al., 2023a), there has not yet been any overview of the range of possible legal and governance solutions to upscaling marine and coastal restoration.

Here we identify and analyse the main legal and governance barriers to marine and coastal restoration, followed by discussion of a broad range of solutions from across the globe. This does not purport to be a comprehensive review of all literature and all possible solutions to these issues, but rather it provides a selection of examples with the aims of inspiring other countries to consider targeted reform, and sparking further research and discussion in this field. In turn, this can contribute to facilitating the rapid upscaling of marine and coastal restoration and achievement of Target 2 of the GBF.

2. Methodology

There is a large body of existing research on legal, policy and governance barriers to restoration, including a recent structured literature review on legal barriers (Foster and Bell-James, 2024). We use 'legal' in this context to refer to laws enacted by Parliament including sub-ordinate arrangements made under power delegated by Parliament (e.g., regulations, directives, binding notices etc). In some jurisdictions, (e.g., common law countries) it also includes decisions of courts and tribunals establishing and extending legal doctrines (such as tort or contract law). Although they are often conflated in the literature, we use 'policy' to refer to non-statutory instruments made by governments, such as plans and guidelines (Bell-James et al., 2024c). Governance, on the other hand, is a far broader concept, encapsulating the *institutions, structures, and processes* that determine who makes decisions (in this case, about restoration) and the basis on which decisions are made (Graham et al., 2003; Lockwood et al., 2010; Bennett and Satterfield, 2018). Restoration governance, then, is more than just the domain of government (Rosenau and Czempiel, 1992) and includes the behaviours, resources and influence of numerous 'non-state actors' such as environmental NGOs, Indigenous communities, and private landholders.

This paper is structured around five key legal and governance barriers to marine and coastal restoration which have emerged from the literature: (a) the lack of fit-for-purpose permitting processes for restoration projects (Bell-James et al., 2023a; Cortina-Segarra et al., 2021; Puckett et al., 2018; Razak et al., 2022; Saunders et al., 2022), (b) complex land tenure arrangements in marine and coastal environments (Bell-James et al., 2023b), (c) concerns about risk and liability arising from restoration (Holley et al., 2018; Bell-James et al., 2023), (d) the lack of overarching legal and policy objectives for restoration at the landscape scale (Bell-James, 2023a), and (e) fragmented governance arrangements, with multiple agencies and stakeholders involved in making decisions about restoration (Sánchez-Arcilla et al., 2022; Cvitanovic et al., 2024).

We chose a 'bright spots' framing for our research, an approach that has previously been used in environmental and conservation studies to identfy examples of early success in a given field (Cvitanovic and Hobday, 2018; Saunders et al., 2020). To find examples of bright spots in addressing these legal and governance barriers, we first searched the published literature in the English language (in May-June 2024) using Google Scholar and Scopus, and combinations of search terms including "restoration" AND "coastal"/"marine" AND "law"/"-legal"/"governance". We also searched Google for grey literature, to find any solutions canvassed in material published by governments, consultants, and environmental NGOs. Finally, we are a large group of authors comprising legal scholars, scientists, and restoration practitioners, working across multiple countries. We supplemented our searches with examples that we have professional knowledge of from our work.

We selected several bright spots for each legal and governance barrier, aiming to span the five barriers as well as cover different jurisdictions, ecosystems and restoration project types. Our selection is outlined below in Fig. 1.

We acknowledge that our results involve a limited selection of bright spots, and this paper is therefore not intended to be a comprehensive review of all possible solutions to legal and governance barriers to marine and coastal restoration. This would be a particularly challenging task because the literature on solutions spans multiple disciplines and literature bases, including grey literature and government documents, many of which would not be publically available. A systematic review would also require a much deeper analysis of the particular legal and political context of each example country, which is beyond the scope of this paper. We also acknowledge that our solutions cover those written up in the English language, which necessarily biases our results to examples from the Global North. A fruitful area for a future, large-scale research project would be to more comprehensively and systematically catalogue examples of progress, including from the Global South, and the non-English literature.

3. The legal permitting process for marine and coastal restoration

3.1. The barrier

In many countries, environmental law encompasses a suite of principles and regulatory tools which were developed and enacted to promote preservation of the natural environment (Akhtar-Khavari and Telesetsky, 2016). These tools include conservation of the most highly-valued landscapes and seascapes through the establishment of

protected areas, and outside these protected areas, control of development through environmental impact assessment of potentially harmful activities (Lees and Viñuales, 2019). These laws are therefore premised on a conservation paradigm of preservation (McCormack, 2018; Camacho, 2010), where proposed management activities for ecological benefit are subject to the same assessment processes as infrastructure or other developments (e.g. for housing or agriculture/aquaculture). Restoration of landscapes and seascapes may necessarily require some active interference with ecosystems – for example, removal of structures to restore tidal inundation may involve some disturbance of vegetation and regrading of intertidal areas. This type of active intervention may therefore fit uncomfortably in a legal regime that is premised on preserving the status quo by restricting (development) impacts (Foster and Bell-James, 2024).

Most countries (187 of 217) have laws requiring some level of environmental impact assessment process for activities and development that have the potential to harm the environment, accompanied by a regime of government-issued permits or approvals to allow these activities to proceed (United Nations Environment Programme, 2019). Restoration projects typically require permissions which are obtained through environmental impact assessment regimes. In the coastal and marine context, this process is expensive and time-consuming, involving a multitude of different permits issued by a range of government agencies (Fitzsimons et al., 2020; Shumway et al., 2021). For these reasons, legal permitting has been identified as a major barrier to the uptake of restoration projects in Australia (Bell-James et al., 2023c; Saunders et al., 2022a), parts of the United States (Craton, 2022; Grenier et al., 2021), South-east Asia (Razak et al., 2022), and in Europe (Cortina-Segarra et al., 2021). As many current legal frameworks were not developed for this type of intervention, it can also be difficult to ascertain which permits will be required for a proposed project (Razak et al., 2022), both on the part of the proponent, and on the regulators assessing the project (Bell-James et al., 2023a). This is compounded when restoration proponents are given short timeframes for delivery by external funding bodies (Gatt et al., 2022; Lovelock and Brown, 2019), and impact assessment processes may exceed the duration of that funding (Bell-James et al., 2023a).

The complexity of a site's permitting process has consequently emerged as a key factor in the selection of sites for marine and coastal restoration (Puckett et al., 2018). The sites practitioners select for restoration can be more strongly influenced by the ease of navigating the permitting system than the biophysical or social appropriateness of the site, or its potential to maximise ecosystem benefits (Bell-James et al., 2023a). For example, the presence of native vegetation may trigger the need to obtain additional permits for potentially disturbing the extant vegetation. In New South Wales, Australia, *Posidonia* seagrass restoration is complicated as it is a listed ecosystem, and therefore cannot be harvested for transplanting without permits. For this reason, focus has shifted to sourcing naturally-detached shoots through a citizen science program for replanting (Ferretto et al., 2021). In other instances, proponents have chosen sites with no existing vegetation to reduce the time and costs associated with obtaining additional permits (Bell-James et al., 2023a). Avoiding sites with extant vegetation is unfortunate because that vegetation can facilitate natural regeneration (Renzi et al., 2019; Teutli et al., 2017).

3.2. Bright spots and potential solutions

Solutions to permitting complexity vary depending on a government's appetite for reform and the potential for inter-agency coordination. A strong intervention would be to address permitting challenges through large-scale law reform. Law reform could include new legislative frameworks to create a single permit for restoration projects, or the implementation of blanket permits that apply to multiple similar projects (Grenier et al., 2021). For example, California's *Habitat Restoration and Enhancement Act* provides a bright spot in this area. It was enacted in 2014, providing a fit-for-purpose approvals process for projects that meet eligibility requirements, including that the project is: small-scale (less than five acres); for 'habitat restoration', meaning it has a primary purpose of enhancing fish and wildlife habitat; voluntary habitat restoration, and is not required as mitigation (i.e. an offset); compliant with best practice methodologies; and will not result in cumulative adverse environmental impacts that are significant (Fish and Game Code §§1651–1652). If a proponent is eligible to apply under the scheme, they only need to apply for one permit, with lower application fees, and a decision required from the assessing government agency within 30–60 days (Grenier et al., 2021).

Whilst there are clear benefits to the Californian approach, this ambitious scale of law reform may be reliant on the cooperation of multiple government agencies. Where this type of cooperation or scale of reform is not feasible or practical, smaller-scale law reform could target individual permit requirements, to formally recognise a difference between development for infrastructure (and other land uses) and projects aiming to deliver ecological benefit (Hamman et al., 2020). In Australia, Shumway et al., (2021) proposed that some government-issued permits could be replaced with a self-assessable code, with a project allowed to proceed on the basis that it complies with the code requirements. For example, the State of Queensland, Australia, has adopted a self-assessable code for restoration that involves removing nuisance marine plants (see Supplementary Table). Provided a proponent follows the requirements in the code, they do not need to seek a permit. However, a self-assessable code would only be feasible in jurisdictions where there is likely to be compliance on the part of regulated parties, and the process is accompanied by requirements for monitoring to prevent misuse of the code.

Guides to navigating the permitting system may assist restoration proponents and could be used when the opportunity for law reform is unavailable. For example, for oyster reef restoration in the U.S., an inventory of permitting requirements for restoration was developed for all 21 coastal states (Mississippi-Alabama Sea Grant Legal Program, 2014), and summarised in global guidelines on shellfish reef restoration (Fitzsimons et al., 2019). Similar permitting guides are being developed for restoration activities in Australia (Bell-James et al., 2024b). While such guides provide instructions to navigate permitting processes and therefore alleviate some of the problems outlined above (i.e. difficulties in ascertaining what permits apply), they will not necessarily lead to faster permitting timeframes, and funding regimes for coastal and marine restoration works also need to allow for funds and time to obtain permits.

4. Land tenure and ownership in coastal and marine zones

4.1. The barrier

Land tenure complicates the selection of sites for marine and coastal restoration. Depending on the jurisdiction and its legal rules, the project type, and the coastal profile, a chosen restoration site may be privately-owned, publicly-owned, owned by no-one, span multiple tenures, or the tenure may be unclear. Where an ecosystem spans multiple tenures, this may also result in different government agencies or groups having responsibility for different components of the same resource.

Ecosystems like mangroves occupy the intertidal zone, an often-contested space (Friess et al., 2016), where different ownership regimes such as privately-owned and government-owned land converge (Rog and Cook, 2017) making it difficult to determine who has legal rights and obligations in relation to an ecosystem (Bell-James et al., 2023b). Other restoration activities such as seagrass planting or oyster reef reconstruction and coral reef restoration occur further out to sea, where the underlying ownership may rest with a national or sub-national government (e.g. in Australia or the United States; Bell--James et al., 2023b; Carboni, 2011), be held in customary ownership (e.g. Pacific Islands; Tilot et al., 2021), or may be subject to future claims

by Indigenous peoples (Mossop, 2020). In these instances the time required to obtain consent from a government agency or Traditional Owners – and allay any fears about risk, as discussed below – can delay or halt restoration progress. In these instances, ideally, moving from a consultation to a co-design or co-delivery process would be recommended to deliver the best possible restoration outcomes, however, these processes take time. Mapping a pathway to co-design with Indigenous groups could help to facilitate this process (Saunders et al. 2024b).

In some circumstances, restoration practitioners have actively sought to avoid tenure disputes by undertaking projects on land that is not privately owned (Lovelock and Brown, 2019), or in areas not subject to any tenure disputes (Sasmito et al., 2023). In the case of mangroves, this has often led to planting lower in the intertidal zone than mangroves naturally occur, and has perversely led to attempts at ecosystem conversion to mangroves in mudflat or seagrass habitats (Song et al., 2023) – both of which are important coastal ecosystems that should be protected and restored in their own right. Further, as these lower intertidal areas are unsuitable for mangrove growth, these efforts have failed, with loss of mudflat and/or seagrass also occurring as part of the attempt (Lee et al., 2019; Sasmito et al., 2023).

4.2. Bright spots and potential solutions

There is no one-size-fits-all solution to land-tenure issues, because tenure regimes vary among sites, and from country to country. Potential coastal restoration sites may be situated on private land, public land, or mixed-tenure sites (especially in the intertidal zone), and may also be subject to Traditional Owner interests. Given the intersection of multiple interests, any of the bright spots canvassed in this section must be considered with care, ensuring that public and community interests are taken into account.

Restoration in the intertidal zone is particularly complex as these sites often involve the intersection of public and private ownership, and the precise boundary may be difficult to determine. Bell-James et al., (2023b) proposed that legislative reform may be the ideal solution to provide tenure clarity in these circumstances, but government support for legislative change may be difficult. Alternatively, legal mechanisms may be developed to create new types of rights in the intertidal zone. For example, in the Philippines, Community-Based Forest Management Agreements offer a useful bright spot to consider. These are used to give community rights to management of a mangrove area for 25 years (Primavera and Esteban, 2008). While there are questions as to whether such rights have improved livelihoods or simply burdened communities with responsibilities (Pulhin and Tapia, 2015), this does provide an example of a type of legal right that can be employed to provide security of tenure in the intertidal zone. In Australia, it has been suggested that contractual arrangements may be a more feasible option than legislative reform. For example, under Australia's *Carbon Credits (Carbon Farming Initiative – Tidal Restoration of Carbon Ecosystems) Methodology Determination 2022* (Cth), carbon credits can be granted for projects that involve removing artificial barriers to tidal flow and reinstating coastal wetlands. These projects involve some uncertainty as to where the legal boundary will be once reintroduction occurs, but contractual arrangements between a government and private landholder can allow a restoration project to occur in the intertidal zone and to delineate where rights (e.g. to stored carbon) will lie (Bell-James, 2023b).

Restoration of marine and coastal ecosystems on land located entirely in private ownership will be more straightforward than mixed-tenure sites as rights and ownership can be clearly identified, but restoration remains reliant on landholder cooperation. Private landholder cooperation can be supported by financial incentives (e.g. reduction in taxes or grants, Niemeyer et al., 2020; Selinske et al., 2022), or market-based incentives like carbon credits (Bell-James, 2023). For example in Vietnam there are multiple domestic and international programs to incentivise mangrove planting in and around aquaculture ponds (acknowledging that there are important considerations to ensure this type of activity is effective – see e.g. McSherry et al., 2023). Care must also be taken to ensure that such schemes are not thwarted by conflicting government priorities, such as policies to promote aquaculture that may lead to mangrove deforestation (as occurs in Vietnam; Pham et al., 2022).

Restoration on land or waters entirely in public ownership can be facilitated through mechanisms to allow for better access to and secure rights over government-owned lands for restoration. For example in the oyster reef context, aquaculture leases have been suggested as a viable model that can be adapted to secure legal rights (Bishop et al., 2023). Aquaculture leases are a type of legal right to occupy and use a designated part of the marine space, and depending on the jurisdiction, may grant an exclusive right to the area (Bell-James, 2016). Aquaculture leases have been used in Hong Kong as a way to give oyster leases legal protection from harvesting (Chan et al., 2022). However, it is noted that restoration on public land is interlinked with the need to address concerns about risk and legal liability as discussed below.

Finally, sea-level rise may result in ecosystems previously located on public land migrating inland on to private land (Bell-James et al., 2023b). Innovative legal mechanisms such as 'rolling covenants' may be used to designate a restoration area that 'rolls' inland with sea-level rise, allowing a balance between short-term productive use of land and the medium- to long-term need to accommodate ecosystem movement (Bell-James et al., 2022), but this will require a change in policy and practice to embrace restoration in conservation covenanting programs (Richardson et al., 2024).

5. Management of risk and legal liability for restorative interventions

5.1. The barrier

In addition to the risk of restoration project failure (Stewart-Sinclair et al., 2020), there is also the potential for a restorative intervention to introduce risks into the broader environment. For example, a constructed oyster reef may provide a navigational hazard for boaters (Bishop et al., 2023), and a project to restore tidal flow to a drained, low-lying landscape may risk inadvertently flooding neighbouring properties (Bell-James and Lovelock, 2019; Sayles, 2018), or impacting biodiversity values of freshwater wetlands that have established in the drained landscape (Houston et al., 2023; Canning et al., 2023).

Risks created by restoration place governmental permitting authorities in a quandary, where they need to weigh a project designed to deliver environmental benefits (that may be perceived as speculative given the early stage of coastal and marine restoration) against a public liability risk that may result in legal action against that same government authority. This notion of balancing the risks of no restoration occurring versus the risks that may flow from restoration occurring is novel, and one for which governments have no concrete benchmarks or guidelines to draw upon (Holst, 2023). The perceived risks of restoration may also affect community support for restorative initiatives. For example, a survey conducted regarding oyster restoration in the Hudson-Raritan estuary (United States) revealed some community concerns that oyster reefs would introduce biosecurity and public health risks (Holley et al., 2018). Perceived risk may also influence the ability to secure contractors to carry out works. For instance, marine contractors in Chesapeake Bay (USA) have been resistant to implement living shoreline techniques due to perceived potential liability for project failures (Davis and Luscher, 2008).

In Australia, Bell-James et al. (2023a) interpreted that some government agencies have taken a risk averse approach to marine and coastal restoration. In the oyster reef restoration context, proponents have had to accept in perpetuity liability for reef structures, with a corresponding need to mark structures (e.g. with a buoy to reduce navigational hazard) and obtain insurance (Bell-James et al., 2023a). In

contrast, in Louisiana in the United States, oyster reefs do not require navigational signage or assumption of liability by the proponent. However, this has led to fierce opposition from coastal property owners who are concerned that liability may fall upon them instead (Craton, 2022). Risk problems are not unique to oyster reef restoration: for example in the United States, a tidal reintroduction project resulted in unintended flooding of a neighbouring property, which led to broader risk concerns that have made operationalising further restoration more difficult (Sayles, 2018). In all of these examples, there is a potential negative effect on future restoration progress, due to proponents being unwilling to assume additional risk, or face the risk of community opposition.

An important part of the puzzle may therefore be the need to 'de-risk' restoration. Eliminating all risk is an impossible task, but passing all risk to the proponent may not be a viable solution either, as the costs of meeting that risk may outweigh the benefits of proceeding with a restoration project. The solution may need to comprise a range of measures, from technical and legal through to education and communication.

5.2. Bright spots and potential solutions

Technical solutions include using signage or buoys to warn of navigational hazards in water, a technique that has been employed in the Netherlands in relation to submerged tree reefs (Dickson et al., 2023). With respect of restoration projects to rehydrate drained wetlands, hydrological modeling can be used to understand how to implement tidal reintroduction to reduce the risk of unintended flooding to neighbouring properties – this has been mandated under Australia's Blue Carbon Methodology (Bell-James, 2023b).

Conflicts between restoration and other land and water uses can also be addressed through zoning and marine spatial planning. Marine spatial planning has a long history for managing uses in protected areas (e.g. Day, 2002), and is increasingly being considered as a viable method to designate sites for restoration and preclude other uses – in turn, lowering some liability concerns (e.g. of property damage or injury from collision with an oyster reef). For example, in Indonesia, the Ministry of Environment and Forestry includes 'rehabilitation zones' within their typology of zones that can be designated in protected area zoning plans. Protected area managers designate these areas with specific objectives for ecosystem recovery that may include restoration activities (KKP, 2021). Zoning has been proposed for Louisiana, United States, to support oyster reef restoration: oyster areas have been zoned into 'broodstock sanctuary reefs', as well as zones for restoration, and zones for agriculture (Swam et al., 2022). To reduce risk concerns, this type of zoning can also be used to restrict boating and fishing in areas where navigation might become difficult due to the presence of submerged reefs. This would in turn reduce the risk of loss or damage occurring.

Legal solutions to mitigating risks may include insurance for restoration projects to cover loss or damage associated with the materialization of the hazard (e.g. property damage from flooding or personal injury caused by a boat colliding with an oyster reef structure). Insurance would need careful consideration as to who bears the cost of maintaining a policy – especially where a government, and indeed the community more generally, shares in the benefits of a restored landscape. Governments could look to other aspects of their operations where they invest in infrastructure that may result in risk to the general community. For instance, children's playgrounds are provided by governments, with a commensurate risk that a child will injure themselves, but this risk is obviously viewed as tolerable, insurable, and outweighed by the community benefits derived from the infrastructure. Additionally, governments can consider any risk management approaches that could be used to lower the risk profile. For example, in the coastal ecosystem context, urban coastal wetlands are habitats for mosquitos which can be vectors of disease and therefore pose a public health risk to communities. Despite this, governments preserve coastal wetlands due to the benefits they provide, and manage risk through management of mosquito populations (Haas-Stapleton and Rochlin, 2022).

Legislative amendments to limit liability from attaching to restoration practitioners or private landholders (Craton, 2022) could also encourage further investment in projects. Consideration must also be given to whether restorative interventions are viewed as built infrastructure, or whether the objective is for restoration projects to become part of the natural environment. In the latter case, this may preclude the need for any separate liability requirements. For example, for the Loch Linnhe artificial reef in Scotland, liability in the construction/deployment phase was the same as any other marine engineering project; however, post-deployment, the proponent was granted a permanent deposit license which reduces or eliminates liability (Consultants, 2003). Another model is the United States 'Rigs to Reef' program, whereby obsolete oil rigs can be transformed into artificial reefs (Macreadie et al., 2011). Generally the operator of an oil rig holds a lease over part of the seabed, and is subject to requirements to decommission the structure at the conclusion of their lease. Under government policy, the operator can be granted a departure from these removal requirements if the government assumes responsibility for the structure under an artificial reef program. The operator may first need to satisfy any navigational requirements for the structure. Once this is finalised, the State will assume title and, critically, liability for the structure (Bureau of Safety and Environmental Enforcement, 2013). Importantly, this contemplates the operator taking steps to reduce risk (e.g. navigational hazard risk) before the government assumes title. Similarly, a legislative regime to limit ongoing liability for restoration proponents could be supplemented by the technical solutions mentioned above.

Education and communication are also critical, and may involve surveying or talking to stakeholders to understand the root of their risk concerns, and, where appropriate, incorporating these concerns into project design and site selection to reduce risk - an approach underway in the context of oyster reef restoration in the Hudson-Raritan Estuary in New York and New Jersey (Holley et al., 2018) and in Sydney Harbour in Australia (Howie et al., 2024). Restoration of coastal ecosystems enhances biodiversity and fisheries, improves water quality, contributes to carbon sequestration and reduces flooding from storms and sea level rise (Barbier et al., 2011; Gilby et al., 2021; Sheaves et al., 2021; Weinstein et al., 2021). Therefore, delaying restoration efforts can in fact increase risks to communities, particularly with climate change, and is a missed opportunity for improved delivery of ecosystem services (Hagger et al., 2022).

Communication with stakeholders can allow for a discussion and weighing up of the risks involved both with restoration occurring, and not occurring. Research has shown that education can help with fostering an increased understanding of the environmental benefits of restoration, whilst also alleviating concerns about, for example, public health implications of restoration (Holley et al., 2018). Another example comes from an oyster reef restoration project in the Noosa River Estuary in Australia, which has seen proponents select some sites specifically for educational purposes, with the project co-designed with the local community (The Nature Conservancy, 2021). Importantly, this project is showing early signs of success (The Nature Conservancy, 2023).

The environmental benefits of restoration can also be communicated through mechanisms that explicitly recognise the financial value provided by ecosystems. For example, natural capital accounting provides a framework so that ecosystem value can be communicated in financial terms, and that increases in ecosystem condition or extent are quantified and adequately assessed, e.g. System for Environmental Economic Accounting (SEEA) (United Nations, 2021). For instance, Australia's 2021 National Ocean Account experimental estimates reported that mangroves and saltmarshes provided coastal protection services for 150 thousand dwellings occupied by 280,000 people (Australian Bureau of Statistics, 2022). Measures such as these can underpin discussions and models on trade-offs among actions such as development, protection, or restoration of natural assets (Mills et al., 2016). Alternatively,

mechanisms like the Singapore Index on Cities' Biodiversity can be useful to quantifying and communicating the value of healthy biodiversity in a city (Chan, 2024).

Discussions about the risks and benefits of restoration should consider the timescale of the accrual of benefits. Restoration can restrict the short-term access and provision of natural resources to local communities, even though substantial environmental benefits are expected in the future. For example, in Mexico, adding culverts to existing highways to promote hydrological flows could restore over 600 ha of degraded mangroves, but managers would be required to negotiate subsidies with local communities due to the expected initial disruption in shrimp catch, the main source of livelihood in the area (Villarreal-Rosas et al., 2024). Decision-makers could consider both short and the long term benefits of restoration by, for example, using decision support frameworks (see e.g. Gregory et al., 2012) that include consideration of both risks and benefits when designing and implementing restoration programs (Lester et al., 2020).

6. Objectives for restoration at the land- and sea-scape scale

6.1. The barrier

Restoration success may be hindered by a lack of overarching legislative infrastructure setting out objectives for restoration across the landscape and seascape. Usefully, the GBF provides both a target (at least 30 %), and also an objective – that restoration occurs 'in order to enhance biodiversity and ecosystem functions and services, ecological integrity and connectivity' (Convention on Biological Diversity, 2022). However, unless Target 2 is translated into an overarching legal and policy framework at the country level, there is a risk that restoration will not be carefully planned to meet these objectives (Bell-James et al., 2024a). To date, a large amount of marine and coastal restoration has occurred in an ad hoc, uncoordinated (Fitzsimons et al., 2015), and 'opportunistic' manner (Saunders et al., 2024a), often in response to government funding initiatives. Without overarching legal objectives for restoration, incorporating best available science, as well as Indigenous and community perspectives, projects will continue to be chosen in response to various different rationales and drivers.

For example, rapidly developing global blue carbon markets may motivate extensive opportunistic coastal ecosystem restoration but towards a singular goal of generating carbon credits. While blue carbon projects can be designed to maximise biodiversity improvements (Heimhuber et al., 2024), and to provide ethical outcomes for local communities and Indigenous groups (Atchison et al., 2024), this may not be an objective in all jurisdictions, and proponents may be motivated to simply maximise carbon credit generation. Sites selected for having the highest carbon benefits do not necessarily accommodate the best sites for achieving biodiversity objectives (Dabalà et al., 2023; Sievers et al., 2023; Hagger et al., 2022), and may have the potential to exacerbate inequalities if not carefully planned (Atchison et al., 2024). Furthermore, an essential feature of carbon markets is the legal requirement to prove 'additionality' of a project, which may lead proponents to areas without existing vegetation that do not have the best chance of success (e.g. planting on unvegetated mud flats has failed in some regions; Lee et al., 2019). The difficulties in proving additionality in some landscapes may mean that restoration is prioritised in areas where additionality calculation is more straightforward. For example, it is difficult to prove additionality for seagrass benefitting from water quality improvements that result from diffuse actions in catchments (Lafratta et al., 2020). Where additionality is a major goal motivating a restoration project, it may also lead to a preference for planting invasive species in situations where a landscape would in fact benefit from removal of vegetation. For example, in China the invasive saltmarsh species *Spartina alterniflora* has been introduced into the landscape and is a net carbon sink but it leads to reduced biodiversity and other ecosystem services (Qi and Chmura, 2023). This illustrates the importance of careful planning to articulate the goals for ecosystems within a jurisdiction – which may include carbon sequestration, but also improvement of ecosystem function, biodiversity, socioeconomic, and cultural values – and ensure restorative actions contribute to these goals.

6.2. Bright spots and potential solutions

Explicitely articulating restoration goals and targets at the national level (or regional level where appropriate) will reduce the possibility of perverse outcomes. An emerging bright spot in this area is the European Union's ('EU') Nature Restoration Law ('NRL'), which became law in June 2024. The NRL is based on the EU's Biodiversity Strategy for 2030, and seeks to provide binding legal targets for member states. The NRL consists of several key elements, including an obligation for member states to put in place 'the restoration measures that are necessary to improve to good condition areas of habitat types … which are not in good condition', with a target of 30 % by 2030, and 90 % by 2050 (Articles 4.1 and 5.1). Importantly, the NRL has separate articles addressing the terrestrial and marine realms, and then breaks these targets down into habitat types, to encourage effort to be spread across all realms and habitat types. For example, listed habitat types for marine areas include seagrass beds, macroalgal forests, and shellfish beds, amongst others (Article 5.1; Annex II). The NRL is centered around biodiversity, referring extensively to the need for restoration to support connectivity of habitat (Articles 4 and 5), and with biodiversity prioritised in the objectives of the Law (Article 1) (EU Regulation 2024/1991).

Although these are ambitious targets, there is (like many international instruments) a gap between ambition and the mechanisms necessary to achieve them. Success of these targets will likely be dependent upon voluntary actions to progress them, which may require significant government investment to incentivise the uptake of restoration (Hering et al., 2023). Although this need for funding is a perennial problem in restoration Saunders et al., 2022, 2024a), ideally the overarching objectives of the NRL will ideally guide restoration in a more coordinated fashion.

Finally, it is critical that any landscape-scale restoration approach plans for future climate change and anticipated sea-level rise, to ensure that restored ecosystems are not lost to incoming tidal inundation. Governments are already addressing sea-level rise in coastal wetland adaptation plans, such as by allowing for migration by changing coastal zoning to allow for set-backs or acquiring coastal land from private land holders (Leo et al., 2019). In the restoration context, legal obligations can be used to ensure that proponents factor sea-level rise into their project design. For example, Australia's Blue Carbon methodology requires proponents of reintroduction of tidal flow projects to forecast changes in vegetation due to sea-level rise, and include that land in their project area (Australian Government Clean Energy Regulator, 2022).

Landscape-scale plans are also necessary because sea-level rise interacts with other features of the connected land-seascape. For example, saltwater intrusion caused by sea-level rise can be accelerated by freshwater abstraction (White and Kaplan, 2017). Additional saltwater can either threaten or support coastal saltwater habitats. The scope of legal governance that should be considered for restoration could therefore be argued to extend upstream to governance of freshwater flows (e.g. governance of agricultural water use, White and Kaplan, 2017).

7. Fragmented governance

7.1. The barrier

The challenge of fragmented governance in environmental management is commonplace at all levels of political institutions; from local-level governance up to national and supranational regimes (Biermann et al., 2020). Building on our definition of governance (earlier), fragmented governance refers, generally, to the unique set of challenges that

uncoordinated decision-making poses to environmental management. Fragmentation of decision-making may occur, for instance, between government agencies or ministeries at the same scale ('intra-government' fragmentation) or between the various scales of government within a political system ('inter-governmental' fragmentation). It may also occur between state and non-state actors where resources and authority are dispersed and held unevenly across the governance system (Scott, 2001; Burris et al., 2005).

To be clear, a plurality of actors in governance is not necessarily a problem in and of itself, and as argued below, harnessing the knowledge and expertise of Indigenous and local communities has distinct advantages over state-led agendas. Generally speaking, however, uncoordinated decision-making is likely to lead to restoration inefficiencies, investment uncertainty and a lack of strategic alignment over the longer term. Indeed, the problem of fragmentation, in whatever its form, has proven particularly problematic in coastal and marine areas (Kelly et al., 2019), especially in locations with inter-jurisdictional coastal systems (Dadon and Oldani., 2017); high seas fisheries (Blanchard, 2017) and in areas beyond national jurisdiction (Ardito et al., 2023; Berry., 2021). Horizontal and vertical fragmentation is a challenge for conservation of marine biodiversity (Techera and Klein, 2011); and for marine governance generally (Kelly et al., 2019; de Oliviera et al., 2024).

7.2. Bright spots and potential solutions

In some cases, even in complicated jurisdictional and political systems, national legal frameworks may assist in charting a more fit-for-purpose and collaborative approach. In Japan, for example, legislation was passed in 2002 for the Promotion of Nature Restoration (Nature Restoration Act), offering a useful bright spot to consider. To date, over two dozen major restoration projects have been facilitated through the legislation, including in relation to tidal flats, and riparian and coral ecosystems (Hamman, 2019; MOEJ, 2019). One of the key principles of the Nature Restoration Act is that restoration should occur in cooperation with a range of state and non-state actors (i.e. collaborative governance).

Restoration projects must have a 'primary government sponsor' either at the national, prefectural or municipal level. Japanese law then requires the 'effector' of the project to establish a committee to facilitate restoration with members such as local residents, scientific experts, municipal governments and 'concerned' national governmental agencies (Hamman, 2019). Membership of these restoration committees seems relatively large, ranging from a few dozen representatives to over fifty members MOEJ, 2009). Despite anecdotal evidence, it is unclear exactly how effective Japan's committee system is at overcoming the problems of fragmented decision-making and further empirical and comparative work may be required to validate its reported successes (Hamman, 2019).

This type of co-designed approach to restoration may be particularly important in locations with high social or cultural values or where the restoration is novel. For example, in the Great Barrier Reef where more emerging approaches to restoration and adaptation for coral reefs are being proposed (McLeod et al., 2022), stakeholder and rights-holder advisory groups and community panels are being used to provide advice and insights on the restoration actions with the goal of better incorporating broader perspectives and opening a dialogue between restoration scientists and community members (McLeod et al., 2022).

Coordinating mechanisms may also be particularly useful when regulating ecosystems that traverse Ministerial portfolios. For example in Indonesia, mangrove governance is split across the Ministries of Environment and Forestry and of Maritime Affairs and Fisheries respectively, depending on their location in the landscape and seascape. There have been various mechanisms used to coordinate governance, but the current approach, at least in terms of addressing intra-government fragmentation, is a high-level Presidential Regulation 108/2020 which establishes a strategic coordinating team for wetland management, and brings together government agencies (Mursyid et al., 2021; Sidik et al., 2023).

Alternatively, or in addition, leveraging the knowledge and expertise of traditional landholders and Indigenous communities is likely to prove particularly beneficial to restoration efforts. Research has shown, for instance, how Indigenous communities, rather than governments, have taken the lead on river restoration, highlighting the importance of culturally-embedded strategies and the need to 'decolonise' governance (Fox et al., 2017). In New Zealand, the loss of cultural connection to riverways has proven problematic with solutions said to require collaborative 'whole of system' approaches involving traditional communities supported by legislative change (Paterson-Shallard et al., 2020).

Such thinking is in line with viewing restoration as a form of *societal governance*, rather than a Western scientific endeavour (Richardson and Lefroy, 2016). In local and Indigenous-led efforts, communities become more than just stakeholders, but are 'intimately involved in the very inception and design of restoration projects including choice of goals and governing principles' (Richardson and Lefroy, 2016; Bradby et al., 2016). Fragmentation may therefore be overcome by actor prioritisation and clear roles and lines of authority in decision-making. Indeed, such approaches may occur entirely outside of 'the State', and without any special force of law, for example under Australia's Indigenous Protected Area (IPA) program which traditional landholders enter into voluntarily (Godden and Cowell, 2016). Though not without their challenges (Zeng and Gerritsen, 2015), restoration practices in IPAs have been shown to empower Indigenous landholders, allowing them to restore damage to biodiversity and culture at the same time (Little et al., 2023).

8. Conclusion

With around five years remaining until 2030 – and the intended realisation of Target 2 of the GBF – restoration progress requires urgent upscaling. To date, a large amount of marine and coastal restoration has been 'opportunistic' (Saunders et al., 2024a), occurring in areas where proponents can obtain funding and navigate legal processes – which are not necessarily the most appropriate sites from a biophysical and social perspective, and may in some instances lead to perverse outcomes (e.g. habitat conversion). Key to this upscaling effort is finding solutions to the legal and governance barriers to restoration, especially in the marine and coastal realm, to ensure that restoration can occur at a large-scale, and in the locations where it will have the most beneficial outcomes for biodiversity and communities. The intention of this paper was to shift the narrative towards solutions, and hopefully direct future research towards overcoming these legal and governance challenges. To this end, this paper aimed to provide a non-comprehensive sample of some of the solutions (bright spots) already being adopted across the globe to overcome these legal and governance barriers. What this brief review has shown is that there is ample evidence from across the globe of solutions being introduced through legal, governance, or policy reform, to address some of the more pervasive barriers to marine and coastal restoration.

Whilst our paper does not purport to be a comprehensive review of global practice, nor an in-depth qualitative analysis of each example, it may provide some initial guidance to countries grappling with these legal and governance barriers. When considered in the context of a country's individual legal and political circumstances, these examples might provide useful lessons for domestic law and policy reform – and in fact, these countries can learn from any challenges faced by early adopters (see additional 'considerations for adoption in other jurisdictions' in the supplementary material). However, these must be considered in light of a country's unique circumstances, and particular care should be taken not to perpetuate 'ecological imperialism' through the imposition of Western-based law and governance systems on indigenous and First Nations Communities (Gibbs et al., 2021).

We also intend that this paper will spark further research and

investigation into enablers and solutions to these legal, governance and policy barriers in marine and coastal ecosystem restoration. In particular, we see several key areas for future research. A critical priority is to expand on this global overview, both in breadth and depth, to compile a suite of best practice mechanisms for adoption in other jurisdictions. It is acknowledged that our review has only covered literature published in the English language, and has therefore been biased predominately toward examples from the Global North. It is imperative that future work builds on our paper to canvass examples from the non-English literature, and to highlight important progress underway in the Global South. Future research could also involve a deeper analysis of the socio-political context of 'bright spots', and address matters such as what unique legal and political features exist within a particular jurisdiction that facilitated reform. This could also include empircal research into how political and social support for reform was obtained. Future research could also consider in more detail the post-introduction phase of these law, policy and governance changes, to ensure that these interventions have been effective, both in terms of ecological integrity, and fair and equitable outcomes for communities.

Finally, it is acknowledged that legal and governance reform is not the only thing needed to promote the rapid upscaling of restoration. More information about restoration techniques and better funding models are critical, and proponents should select restoration sites through a systematic framework addressing diverse contraints on the feasibility of actions (e.g. Piccolo et al., 2024). Furthermore, as finance flows become available to fund ecological restoration, projects will require scrutiny to avoid the risks of low integrity projects, or 'greenwashing' through inappropriate use of carbon and/or biodiversity credits (Trouwloon et al., 2023). However, finding solutions to these legal and governance barriers is one of the critical factors needed to promote restoration success.

CRediT authorship contribution statement

Evan Hamman: Writing – review & editing, Writing – original draft, Formal analysis. **Rose Foster:** Writing – review & editing, Writing – original draft, Formal analysis. **Megan I Saunders:** Writing – review & editing, Writing – original draft, Formal analysis. **Catherine E Lovelock:** Writing – review & editing, Writing – original draft, Formal analysis. **Justine Bell-James:** Writing – review & editing, Writing – original draft, Project administration, Investigation, Formal analysis, Conceptualization. **Nathan J Waltham:** Writing – review & editing, Writing – original draft, Formal analysis. **Jaramar Villareal-Rosas:** Writing – review & editing, Writing – original draft, Visualization, Formal analysis. **Nicole Shumway:** Writing – review & editing, Writing – original draft, Visualization, Formal analysis. **Christopher J Brown:** Writing – review & editing, Writing – original draft, Formal analysis. **Dominic A Andradi-Brown:** Writing – review & editing, Writing – original draft, Formal analysis. **James A Fitzsimons:** Writing – review & editing, Writing – original draft, Formal analysis.

Declaration of Competing Interest

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Appendix A. Supporting information

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Data availability

No data was used for the research described in the article.

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