

Managed Retreat in Practice: Mechanisms and Challenges for Implementation

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Summary and keywords

Managed retreat is a deliberate strategy to remedy unsustainable land use patterns that expose people, ecosystems, and assets to significant natural (and socio-natural) hazard and climate induced risks. The term is all-encompassing, broadly capturing planned relocation in the fields of disaster risk reduction and climate change adaptation, as well as managed retreat or realignment in coastal management and environmental planning practice. Managed retreat helps to ensure that people and the resources they value are no longer exposed to extreme events and to the adverse impacts of slow-onset environmental change.

Distinct from migration and displacement, managed retreat is the strategically planned withdrawal from development in risky spaces. It can be applied at a range of spatial scales, in an anticipatory, staged, or reactive manner. Unlike traditional risk management alternatives, managed retreat affords space to natural processes and minimizes long-term maintenance and emergency management costs. While it has great promise as a sustainable disaster risk reduction and climate change adaptation strategy, there are a number of socio-political-cultural, environmental, economic, and institutional barriers affecting its implementation, particularly in contexts with extensive existing development. There may also be significant challenges in integrating relocated and receiving communities. In practice, people are deeply connected to, and reliant upon, the security, networks and cultural values of their lands, homes, communities, and livelihoods. To realize the long-term benefits, managed retreat needs to be considered as an integrated approach that uses information, regulation, and various financial levers in a strategic manner, and recognizes the need to work alongside communities in a fair, transparent, and inclusive way.

Keywords

managed retreat, adaptation, community relocation, natural hazards, disaster risk reduction, climate change, planning

Introduction

Human induced environmental transformation has allowed societies to improve living standards, expand, and progress, but intensive land use and modification of the natural environment can also result in increasing exposure to potentially devastating perils. Humans have drained, deforested, reclaimed, and sealed land, diverted and constrained natural water courses, carved out roads and railways, and built for the masses, altering ecological functions, processes, and landforms (Goudie, 2013; Goudie & Viles, 1997). Traditionally, to manage the adverse interactions between development and environment, the predominant approach has been to control nature, building structures to hold the line against the perils of seas, rivers and debris. However, experience reveals the limits of reliance on protection measures, and the need to focus on more sustainable, long-term risk reduction measures (Burby, 2006; Cooper & McKenna, 2007; Cooper & McKenna, 2008; Gesing, 2016; Jackson & McIlvenny, 2011; Jha, Stanton-Geddes, & Stanton-Geddes, 2013; White, 2013).

In theory, managed retreat is a sustainable form of risk management as it avoids exposure to potentially irreversible harm to human life and assets, promotes restoration of land and ecosystem functions, and ceases the long-term risk management and emergency response costs associated with the initial location. Nonetheless, the relocation of people from their homes, cultural and ancestral lands, networks, and treasured places can impose significant negative social costs and increase human vulnerability in other ways. The challenge is to facilitate

managed retreat in a way that enables sustainable outcomes and builds, rather than diminishes, community resilience.

A review of the international literature on managed retreat, provides a global perspective that holds relevance for both academics researching this field and practitioners struggling with adapting to an uncertain future. Searches for peer-reviewed literature were undertaken in 2018 on the Scopus database using key words; *managed retreat*, *managed realignment*, and *community relocation*. The top 200 results of each search, sorted by relevance, were reviewed, and references listed in selected papers were investigated to broaden the literature review. The key terms were also searched on Google Scholar to identify additional peer-reviewed and grey literature. This approach is designed to introduce the history and development of the strategy, before analyzing its primary mechanisms and challenges for implementation.

In the face of a changing climate, and with increasing global exposure to the impacts of natural and socio-natural hazards (subsequently referred to as natural hazards), it is clear that administrations need to consider how best to supplement the traditional adaptation responses of protectionism—and its inevitable risk transfer—with strategies that can reduce and avoid risks to human life, ecosystems, cultural values, and the built environment. Yet, while it is gaining some traction internationally, managed retreat remains shackled by a range of socio-political-cultural, economic, and institutional barriers.

Managed Retreat History, Terminology, and Mechanisms

Managed retreat is defined as the strategic relocation of people, assets, and activities to avoid and reduce natural hazard risks and to adapt to the impacts of climate change. Change in land use required by managed retreat can affect a wide range of activities: for example, residential, commercial, industrial, recreational, cultural, and rural activities, supporting infrastructure and services, and associated land use values, assets, and structures. The rate and scale of managed retreat depends on that of the risk and the relative enablers in place to overcome the challenges of significant social change. Insurance retreat, where insurance becomes less attainable or unavailable (affecting public and private assets) affects both managed and unmanaged retreat. Unmanaged retreat is self-governed, driven by individual choice under the influence of the market, insurance sector, environmental regulation, and personal risk tolerance.

Bardsley and Niven (2013) posit that managed retreat strategies reflect a change in attitude toward the environment, where humans refrain from altering nature and work towards understanding and respecting it. Unlike displacement or migration, managed retreat is a deliberate strategy to reduce risk exposure and make space for natural processes. The term *managed retreat* emerged in coastal engineering, signifying a shift from the traditional hard protection legacy (Neal, Bush, & Pilkey, 2005). It has evolved to be applied in natural hazard planning more generally, from natural hazard setbacks and relocatable buildings to strategic removal of people and assets at risk. There is, however, varying terminology, focus, and policy drivers among nations. For example, in the United Kingdom, managed retreat is encompassed within the term *managed realignment*, which similarly aims to increase natural flood and storm buffering capacity, reduce defense costs, and increase natural habitat, or provide replacement habitat to compensate for coastal squeeze (DEFRA, 2002). While sustainable flood risk management was the original motivation, pressure to create or enhance intertidal habitat, enhance nature conservation, and dynamically adapt to climate change also contributed to this shift in focus (Esteves, 2014). Although managed retreat is the dominant term in countries such as the United States of America, Spain, Australia, and New Zealand (NZ), the terms *de-embankment* and *de-polderization* may also be found in northern Europe, particularly for the creation of intertidal areas Esteves (2014).

Akin to the deliberate, strategic nature of managed retreat, the term *planned relocation* is also found in the literature. This is a coordinated, planned process in which people and communities are assisted to relocate from their homes or places of residence and settle in new locations with the necessary conditions to rebuild their lives (Ferris, 2017, p. 6). Planned relocation takes place within national borders and may be implemented at the individual, household, and/or community levels. Resettlement, as a component of planned relocation, can be defined as the “process of enabling persons to establish themselves permanently in a new location, with access to habitable housing, resources and services, measures to restore/recover assets, livelihoods, land, and living standards, and to enjoy rights in a non-discriminatory manner” (Weerasinghe, Martin, Turk, Franck, Mc Adam, & Ferris, 2014, p. 10). In less developed nations, managed retreat is often facilitated as planned relocation and resettlement (Tadgell, Doberstein, & Mortsch, 2018). That said, concepts of planned relocation are not new, resonating with deliberations of previous centuries about surplus population and resource scarcity (McAdam, 2015). During the 19th to the mid-20th century, relocation was theorized as a proactive solution to anticipated overpopulation and resource scarcity. Yet, in a similar vein to what we are currently witnessing with managed retreat, history shows that the translation from rhetoric to reality proved difficult in practice (McAdam, p. 97).

These differences in terminology are significant. It should be noted that *managed retreat* is a broader term than *managed realignment*, encompassing risk reduction and adaptive management of a range of natural hazard and climate change risks, not exclusive to water sourced threats or strategic removal of protection works. The term also relates to concepts in disaster risk reduction (DRR) and climate change adaptation fields. DRR emerged following a growing international awareness of the significant impacts that natural hazards impose on societies, and the need to reduce human exposure to natural hazard risk (Ireland, 2010). The Sendai Framework for Disaster Risk Reduction 2015–2030 requires an increased focus on proactive management of disaster risk through active intervention, including a priority to strengthen disaster risk governance by formulating public policies aimed at addressing avoidance or relocation of human settlements in disaster risk-prone zones (UNISDR, 2015, p. 171). Importantly, it also makes prevention and reduction of disaster risk a primary role of signatory governments. In parallel to natural hazard thinking around avoidance and reduction of risk, the “protect, accommodate, retreat” (PAR) logic developed in the context of sea level rise management with the first Assessment Report of the Intergovernmental Panel on Climate Change (Dronkers et al., 1990; Thomsen, Smith, & Keys, 2012). This logic continues to be applied in this field, extending beyond sea level rise management, with efforts continuing to integrate DRR and climate change adaptation (IPCC, 2014).

While there are differences, there are also commonalities. Managed realignment, planned relocation, resettlement, and managed retreat all generally encompass principles of allowing natural processes to persist by removing people and assets away from threatening areas; providing an environmentally sustainable (and sometimes precautionary) approach to risk management and planning for the long-term (Bardsley & Niven, 2013; Esteves, 2014; Neal et al., 2005; Rupp-Armstrong and Nicholls, 2007). The theme of human migration is also visible. At present, displacement, migration, planned relocation, and resettlement are all used to describe human mobility as a result of exposure to disasters and the impacts of climate change. This may be understood as occurring on a continuum of voluntary to forced movement in response to environmental change, and *displacement* is understood as reactive, forced movement that may be temporary or permanent (Weerasinghe et al., 2014). Reflecting upon the literature, managed retreat has been commonly applied in coastal locations, and much discussion relates to retreat from coastal inundation and erosion (Abel et al., 2011; Alexander, Ryan, & Measham, 2012; Bardsley & Niven, 2013; Cooper, 2003; Dyckman, St. John, & London, 2014; Gibbs, 2016; Harker, 2016; Harman, Heyenga, Taylor, & Fletcher, 2015; Klarin

& Hershman, 1990; Kousky, 2014; Zhu, Linham & Nicholls, 2010; Neal et al., 2005; Reisinger, Lawrence, Hart, & Chapman, 2015; Rupp-Armstrong and Nicholls, 2007; Ryan, Goddard, Abel, Leitch, Alexander, & Wise, 2012; Titus, 1986; Young, 2018). However, it can be applied to a range of risks, incorporating an array of techniques that may differ according to distinct locales and riskscapes.

Managed Retreat Mechanisms: New, Existing, and Redevelopment of Land

Information and Education

Provision of information and public education is essential to the assessment of options and strategies to reduce risk. Risk information can come from a range of sources, but certain forms, especially technocratic risk assessments often have greater legitimacy and impact in formal institutional frameworks. Once derived, risk assessments “become” accurate, rational reflections of the world, even though they are, in fact, socially constructed (Tierney, 1999). Risk tolerability differs greatly according to local contexts, vulnerability, and individual perceptions, making the provision of risk information complex and contested. While provision of rational information is beneficial to managed retreat decision makers to provide direction and create legitimacy, information from a diverse set of actors, including local and indigenous knowledge, is vital to ensure equitable, context-specific decision making and inclusive risk assessments. Provision of information is not sufficient to enable managed retreat alone, but it is an essential prerequisite to assessment of options and strategies for decision makers, and it acts to inform individuals to avoid investment in risky localities, and contributes to autonomous, unmanaged retreat.

Regulation

Provision of information can also be regulatory. Robust science and clear communication are important to information disclosure as “liability concerns, special interests, community resources, place attachment, and divergent priorities at different levels of government present powerful constraints” (Reisinger et al., 2014, p. 1385). As risk information develops over time, new and existing development is affected. In New Zealand, as in many countries, local authorities have responsibilities to identify natural hazard risks and provide this information to the public. Local authorities in New Zealand provide this information via local plans, Land Information Memoranda (LIM), and notices on property titles under the Building Act 2004. However, “despite statutory and common law obligations to provide coastal hazard information, local authorities have faced legal and political challenges when attempting to include coastal hazard notifications on property notices” (Harker, 2016, p. 79). For example, Kapiti Coast property owners sought judicial review against the district council after they referenced 50 and 100-year coastal hazard lines on property LIMs. As a result of the review, the information was removed, due somewhat to concerns regarding the accuracy of the hazard lines and the consultative approach taken (Allan & Fowler, 2014). In Australia, there has also been strong objection to the inclusion of climate change risks on land titles (Harman et al., 2015). Negative public reactions to the notification of such information makes it politically difficult for local authorities, who do not want to be perceived as detrimentally affecting private property values and rights. Hazard notification in this manner is often considered a blunt tool that causes shock to property owners, and early and effective community engagement is required for managed retreat interventions, including the provision of information.

Similarly, in the United States, some states have natural hazard disclosure requirements for real estate transactions. Although public disclosure is not expected to prevent sales, it is

expected to affect ultimate sale prices and reflect risk (Harman et al., 2015). However, Zhang, Hwang, and Lindell (2010) recognize that the basic assumption of reduced property values is dependent on the accuracy of people's risk perceptions. In addition to geographic proximity, risk perception may be influenced by hazard information sources, institutional trust, and risk information dissemination methods (Zhang et al., 2010). This recognizes the limitations of information disclosure, and the need for local authorities to maintain legitimacy and trust, supporting formal information disclosure with tailored messages for different types of hazards, communicated to target audiences (Zhang et al., 2010).

Setbacks are a form of land use regulation that sets minimum distances from risky localities, generally applied at the coast (Reisinger et al., 2014). A setback line demarcates where development is prohibited. For example, at the coast, buildings must be located landward of the setback, and if there is existing development prior to the introduction of the setback line, when or if structures are redeveloped, they must be placed landward of the line if space is available, otherwise the site must be retreated from (Esteves, 2013, p. 25). Due to their limited ability to manage existing development, setbacks (and managed retreat in general) are more achievable and effective in underdeveloped localities (Abel et al., 2011; Klarin & Hershman, 1990; Tobey et al., 2010). Neal et al. (2005) elucidate that, while setbacks reflect an avoidance approach, if they do not have the capacity to buffer significant environmental change (as it can be difficult to determine or apply the necessary setback extent over the long-term), they become temporary measures, with assets eventually losing the setback, or its buffering capacity is overwhelmed. This concern was recognized early in the development of managed retreat at the coast, where setbacks in North Carolina (in 1983), Florida (in 1970), and South Carolina (in 1988) were developed with periodic reviews to address this problem, reflecting adaptive management to sea level rise (Klarin & Hershman, 1990). Rolling easements develop this thinking, where regulatory lines shift landward as high-tide shorelines erode (Neal et al., 2005). These allow development to occur (particularly in coastal locations susceptible to sea level rise) under the condition that the exposed property will not be protected, providing natural inland migration of the coast (Titus, 2011). Once land becomes unsafe to inhabit or use, its associated activities, values, and assets are relocated. Texas state law, under the Texas Open Beaches Act 1959, provides a rolling easement that moves with the shore to preserve public beach access (Klarin & Hershman, 1990). However in *Severance v. Patterson* 370 S.W.3d 705 (Tex. 2012), the court found that this does not apply in the case of severe storm events, limiting the ability for managed retreat in response to gradual coastline migration.

Authorities can prevent redevelopment in areas subject to natural hazards to avoid further investment in risky spaces and foster retreat over time. On its own, this represents unmanaged retreat, where private relocation is driven by the market as a result of regulation, hazard experience, and individual risk tolerance. To foster managed retreat over time, authorities can require that redevelopment (and new development) is relocatable, if there remains reasonable use of land in the short-medium term, and relocation triggers, monitoring programs, and conditions are set to activate, enable, and safeguard relocation in the future. However, relocatable buildings on high energy coastlines may not be effective at avoiding and reducing risk to life and assets and must be combined with regulation to avoid private protection attempts to delay retreat (Kirk, 1987). Regulation can also limit redevelopment of damaged or destroyed buildings and infrastructure following significant events. In such circumstances, private insurance (risk transfer) can support property owners with relocation, however pay-outs are often inadequate in comprehensively funding retreat. The literature highlights reactive retreat as an important opportunity, particularly if anticipatory action is unachievable (Abel et al. 2011; Kousky, 2014). Formalizing catastrophes as opportunities for change is best pre-planned, to avoid socio-political rebuilding pressures (Abel et al. 2011; Kousky, 2014).

Another regulatory tool that can enable managed retreat is the prohibition of hard protection structures. Incremental adaptation responses entrench existing rights and expectations about ongoing development and protection, which can generate adverse effects on natural character and amenity values and limit opportunities for adaptation, such as managed retreat (Reisinger et al., 2014). When protection measures are put in place, property owners are given a false sense of security, which may result in additional high value investment in threatened areas, producing an intensification of residual risk. White (2013) explains that, while using public money in this way can be politically attractive, it can enhance longer-term risk via the “escalator effect” (Parker, 1995), or the “safe development paradox” (Burby, 2006), where defences cause the area behind them to seem safe and therefore attract new capital. Using local authority powers to decline applications for hard protection works is a useful tool to raise wider awareness and to ensure alternatives such as managed retreat are considered.

A more stringent approach to enable managed retreat is currently being tested in New Zealand. This involves prohibiting the continued use of land (and the structures upon it) for residential activities in a high-risk zone. Plan Change 17 to the Bay of Plenty Regional Plan is proposed to extinguish the existing use rights of property owners. The change would introduce a rule prohibiting residential activities on identified sites within the high-risk debris flow area. Changes to the District Plan have also been proposed to rezone the land from “Residential” to “Coastal Protection Zone,” prohibiting residential activities and requiring resource consent for any new activities. This approach is possible in New Zealand because there is no constitutional guarantee of property rights; the Resource Management Act of 1991 creates a system in which sustainable management of natural and physical resources takes priority over property rights (Barton, 2003). Nevertheless, the local council recognized the sensitivities at play and offered property buyouts to incentivize relocation before regulation. As this mechanism is being tested, New Zealand case law has not yet confirmed whether compensation for regulatory takings of land will be required. In the United States, *Lucas v. S.C. Coastal Council*, 505 U.S. 1003, 1003, 112 S. Ct. 2886, 2887, 120 L. Ed. 2d 798 (1992) confirmed that uncompensated regulation rendering land valueless constitutes an illegal taking, unless the land use restrictions are inherent to the property or exist in state common law principles. The *Lucas* precedent limited the ability of U.S. governments to regulate land uses without compensation, increasing liability risks to authorities introducing regulatory zones to reduce risk.

Incentives

Acquisition of private property is an effective mechanism for managed retreat, particularly where adverse impacts are known and imminent. Properties and settlements faced with significant risks can be acquired and converted to reserve land or restored to functioning natural ecosystems that deliver mitigating benefits. Property acquisition can be negotiated or compulsory (thus also encompassing regulation), in anticipation of, or in reaction to adverse impacts of natural hazard events.

In countries where private land ownership is standard, land acquisition to achieve managed retreat is typically reactive—for example, buyouts in the United States (Hino, Field, & Mach, 2017), Australia (King et al., 2014), and New Zealand (Canterbury Earthquake Recovery Authority, 2016). Property acquisition is generally applied in an ad hoc manner in Australia and New Zealand, but buyout programs are well-established in the United States. Buyout programs are usually funded by U.S. federal or state governments and managed at state or county levels, enabling residents who no longer wish to live in high-risk zones to sell their properties and move to safer locations (Freudenburg, Calvin, Tolkoﬀ, & Brawley, 2016). The Federal Emergency Management Agency (FEMA) manages a voluntary buyout program where home owners can opt to sell their properties to government if they have been damaged by events and are expected to be repeatedly exposed (Gibbs, 2016). The federal government

guidelines recommend administrators designate priority acquisition areas to target residents for the programs. Buyouts are most commonly applied through negotiated purchases where owners voluntarily sell land. Land acquisition can also occur by eminent domain; however this often results in higher purchase costs (Neal et al., 2005). In England and Wales, compulsory purchase powers are well established for projects with a “national interest” such as the agricultural land that is flooded under managed realignment schemes (Cooper & McKenna, 2008). While buyouts can effectively reduce risk, many are hindered by a lack of funding (Neal et al., 2005). Property acquisition at the coast is most problematic as “any compensation zone moves with time and the costs of compensating every ill-sited development would likely be prohibitive” (Cooper & McKenna, 2008, p. 328). Buyouts of this nature may contribute to moral hazard risk (the effect of incentives on behavior that may increase risks) and raise questions of social justice. While it may be impossible to avoid all moral hazard risk, prerequisites, or conditions determining the buyout value, such as whether property owners knew of the risks associated with their location before purchasing can be imposed, sending a signal that the buyout is discreet, based on specific criteria. Furthermore, responsibility for funding managed retreat can include property owners, which may help to reduce moral hazard risk. Incentivized managed retreat has social justice implications as it transfers private risk reduction costs to the wider public; however, it also produces intangible costs on private owners (as a result of place detachment) and, if effective, will reduce public costs spent on disaster recovery over the long-term.

Fee simple titles are a significant barrier to the implementation of managed retreat, and market values do not always reflect the transience, or risky nature of land. In circumstances where risk to life, ecosystems, and assets are not imminent or high, but are expected to increase over-time, the change of permanent property rights to a fixed term basis would enable precautionary, long-term, managed retreat. To implement this, property could be acquired, then rented or leased for a fixed term, corresponding with adaptive management of the risk. While this option is less feasible with short-term risks, it has some potential where “lease-for-life” terms would be available. Covenants and easements could be used in combination with land acquisition, where provisions are registered on property titles, requiring owners to carry out certain actions or restricting them from such. These can be registered through building and resource consent regimes for new or redevelopment or in the circumstance that governments acquire, covenant, and re-sell or lease a property. Covenants for managed retreat could include requirements that buildings are relocated or removed when a determined level of risk is reached, prohibition of hard protection works, and no complaints of adverse effects from risk exposure. Rolling easements could also be applied following land acquisition at the coast. Disadvantages of covenants and easements include the requirement for land acquisition or change to existing use rights and their site-specific nature, which may not achieve an integrated, strategic approach to managed retreat unless acquisition can target priority areas in a cohesive manner. At the coast, Young (2018) argued that governments must find middle ground between buyouts and unmanaged retreat, suggesting pure leasing, rather than purchase of land by government, to push the market toward risk-reflective pricing. Essentially, this represents a relocation subsidy to deliver managed retreat.

Other incentives to influence investment decisions applicable to private property ownership and other land tenure arrangements include relocation subsidies, land swaps, transferable development rights (Nellermoe, 2016), and tax/rate incentives that direct development pressures away from sensitive localities (Abel et al., 2011).

Disincentives

To supplement regulatory mechanisms aimed at avoiding an increase in risk, economic disincentives can be applied to discourage development in high-risk zones. U.S. federal laws,

such as the 1982 Coastal Barriers Resources Act and the 1990 Coastal Barriers Improvement Act, designate development areas, but buildings in certain locations are not eligible for federal flood insurance or post-storm federal assistance to rebuild infrastructure following extreme events (Neal et al., 2005, p. 605). These disincentives send risk signals to the market and assist in reducing moral hazard risk. However, a different form of moral hazard can also occur at government level, where insurance disincentives reduce government urgency to avoid and reduce risk.

Risk Transfer

Property owners insure their assets to safeguard themselves against adverse effects of investment loss or damage. According to Storey et al. (2017), insurers cover risk where uncertainty exists, therefore insurers themselves will retreat their cover from locations once the risks are “sufficiently probable.” Moreover, “insurance retreat by a single insurer can cause industry-wide retreat,” with potential to decrease asset values as loans become unavailable or more costly (Storey et al., 2017, p. 7). In many countries, insurance is a requirement for residential mortgages. However, as mortgage periods often span decades, but insurance contracts are renewed annually, insurers can exit an insurance market within 12 months, while a lender may have a decades long commitment, potentially leaving them more exposed. It is expected that, in future, banks will be less likely to lend to high risk property owners and coastal property owners, require greater equity, or apply higher interest rates (Storey et al., 2017,). Although insurance retreat is not a particularly appealing mechanism due its financial and social implications, it may be effective at curbing further investment in hazardous locations and progressing gradual retreat. However, its influence alone may be “too little too late” and incapable of producing socially equitable outcomes.

Left to the market, unmanaged retreat may see that, as risk increases and hazardous events become more frequent or damaging, property values decrease, and people eventually retreat as a last resort. This may deliver the greatest amount of power, time, and choice to property owners in managing their risk, but it also brings potential exposure to great harm. Where unmanaged retreat occurs, there are likely to be adverse consequences and opportunity costs, whereas managed retreat could have delivered strategic outcomes with long-term public benefits. Particularly in coastal areas, owners may attempt to protect their properties, even if this requires illegal action. This occurred in Mokau, New Zealand (Waikato Regional Council, 2006), and until recently, it has left local authorities with no option other than to leave an illegal sea wall in place and ignore local attempts to maintain it, as it is providing protection in the short-term and alternatives, including managed retreat, have been rejected in the past. Some property owners believe that the wall will continue to protect them and many do not wish to relocate, a typical example of path dependence caused by protectionism. However, loss of access to the beach and coastal squeeze due to autonomous private protection measures means that this approach may not be environmentally, economically, or socially optimal, legal, or equitable (Kousky, 2014). Pilkey and Cooper (2014) argued that globally, many natural beaches and their associated public amenity and ecosystem functions are at risk of extinction. Due to misplaced reliance on hard engineering to remedy (and ultimately sustain) poorly planned development, thousands of miles of densely developed beachfront settlements (such as those in Florida and Spain) are backed by seawalls, squeezing natural beaches and leaving them unable to absorb the impacts of storms. “In this diminished state, beaches provide a small recreational platform and impaired ecosystem function” (Pilkey & Cooper, 2014, p. 431).

In practice, property owners do not bear the full costs of their decisions to live in high-risk locations; response to hazard events is carried by the wider community through risk and emergency management, and through maintenance or repair of public utilities and infrastructure supporting those areas. As provisions in home insurance contracts do not always

provide for “betterment,” insurers may repair a home that is at risk of future flooding, but they will not subsidize relocation of the home or the construction of a new home on a safer site (Boston & Lawrence, 2018; O’Hare, White, & Connelly, 2015). This makes the insurance sector highly reactive, often only redistributing risk rather than lessening it, and eventually many property owners will be unable to maintain adequate insurance. Therefore, it is likely that, as insurance companies retreat and property values decline, affluent households will be able to relocate, but exposed areas may become populated with poorer people, potentially increasing the vulnerability of the community. In comparison to managed retreat, unmanaged retreat, like any adaptation delivered by the sum of private actions, will not only be inequitable and sub-optimal, but will fail to challenge the land use legacies that create and sustain vulnerability (Waters & Barnett, 2017, p. 710). Reactive, arbitrary actions are likely to impact on the whole community (Kousky, 2014), and over the long-term, managed retreat is potentially more publicly cost effective than protection, accommodation, or unmanaged responses (Alexander et al., 2012). Reducing hazard exposure via managed retreat takes into account the safety of the entire community in a planned, strategic manner, as opposed to ad hoc mitigation measures by individuals (Cooper, 2003). However, costs will inevitably be higher for individual property owners, in an economic, social, and cultural sense.

Strategic Planning

Best practices for effective adaptation, promoted by the *USAID Guidebook on Adapting to Coastal Climate Change* and emanating from decades of integrated coastal management (ICM), recognize that adaptation must be inclusive, strategic, and adaptive (Tobey et al., 2010). Applying the precautionary principle, actions should not be impeded by an absence of full scientific certainty, and the best adaptation response will rarely involve a single approach (Tobey et al., 2010). ICM has long recognized the strategic nature of managed retreat (Klarin & Hershman, 1990), for example, using a range of managed retreat mechanisms, and in combination with other management approaches, such as ecological defenses (e.g., mangroves, reefs, and wetlands) that buffer assets from the direct threats of the sea (Abel et al. 2011).

The mechanisms discussed do not necessarily equate to managed retreat on their own, as it requires a strategic process that employs a number of actions. Dynamic Adaptive Policy Pathways (DAPP) has emerged as a means to help strategic planning decisions under conditions of deep uncertainty (Haasnoot, Kwakkel, Walker, & ter Maat, 2013). Particularly for slow-onset risks, DAPP enables the creation of proactive, dynamic strategies that can respond to change by following a series of pathways and actions, developed with pre-determined trigger points and monitored to adapt with environmental change, unlike traditional static policies that have a “design life” (Lawrence & Haasnoot, 2017). Implementation of adaptive pathways has generally been limited to large scale infrastructure projects to manage floods, droughts, and sea-level rise, for example, in the Thames Estuary and river catchment and in the Rhine-Meuse delta (Haasnoot et al., 2013; Ranger, Reeder, & Lowe, 2013). These projects have been applied at national scales with high technical, institutional, and resourcing capacities (Barnett, Graham, Mortreux, Fincher, Waters, & Hurlimann, 2014; Lawrence & Haasnoot, 2017). At the local level, Lawrence and Haasnoot (2017) detailed the socialization, testing, application, and policy integration of DAPP in the New Zealand adaptation context, and Barnett et al. (2014) provided empirical evidence of the development of a local coastal adaptation pathway in south-eastern Australia. Since its testing and application, DAPP has been integrated into New Zealand national policy guidance to inform the exercise of statutory planning functions and powers.

To understand strategic decision trigger values for managed retreat under DAPP, the proposed adaptation pathway for the township of Lakes Entrance in South-Eastern Australia provides a good example. Barnett et al., (2014, p. 1104) revealed three triggers that were

developed that warrant a change in adaptation policy: (a) flooding on the main road more than five days a year; (b) 1.8 m floods in a year that would have a “diabolical” impact on the township and that trigger (c) a permanent breach of the coastal barrier dune. When trigger “a” is activated, regulations are introduced for new developments to avoid increased exposure to flooding, and proactive planning for alternative development sites directs infrastructure, growth, and eventual relocation to less risky sites. When trigger “b” is met, all low-lying critical infrastructure and habitable dwellings are relocated in a coordinated manner to more elevated sites. Decision-making for trigger “c” is to be reviewed as required to enable actions to be determined by the relevant generations affected. Hermans, Haasnoot, ter Maat, & Kwakkel (2017) recognise the importance of taking into account the presence of multiple actors in decision-making, implementation, and evaluation to support collaborative learning. In particular, technical ‘signposts’ (indicators which help determine if conditions critical to policy success are still being met) are necessary to monitor the external environment, but political signposts are also required to monitor progress in the implementation of agreed policy actions and achievement of policy objectives (Hermans et al., 2017).

DAPP allows communities to prepare for environmental change, delivering a framework to make decisions and provide certainty for the future, with flexibility to adapt to changing circumstances. However, Lawrence, Bell, and Stroombergen (2019) express the complexities of planning over the long-term under DAPP. Important lessons include the impact of simplification in the DAPP process, which reduces flexibility and responsiveness by applying a single sequence of actions, rather than many possible options and pathways to dynamically adapt to environmental fluctuation (Lawrence et al., 2019). The inclusion of consentability assessments of DAPP actions and pathways is necessary to deliver legitimate options that will secure the necessary permits and statutory plan changes to warrant implementation of the strategy (Lawrence et al., 2019). Finally, governance monitoring systems and ongoing political leadership are vital to deliver a robust approach that spans the life of the strategy (Lawrence et al., 2019). Not all adaptation decisions can be made so dynamically, due to the long design lives of infrastructure, or because of immediate risks to human life, ecosystems, or assets. Where risk is high in the short-to-medium term, more immediate forms of strategic planning will be required.

In summary, four primary sources of managed retreat interventions are identified for new and existing development: provision of information and education, regulation, incentives and disincentives, and risk transfer (Table 1). While regulation and incentives hold the greatest potential to enact managed retreat, information and risk transfer can all be seen as part of an integrated approach.

Table 1. Summary of Managed Retreat Mechanisms

Inform and educate	Regulate	Incentivize/disincentivize	Transfer risk
<p>Risk knowledge to inform</p> <ul style="list-style-type: none"> • Market signals to potential buyers, lenders, and insurers • Strategic option analysis for risk reduction 	<p>Regulation can be applied to new, existing, and redevelopment via</p> <ul style="list-style-type: none"> • Planning zones and notifications • Setbacks and rolling easements • Relocatability conditions • Restrictions on redevelopment • Prohibition of rebuilding 	<p>Incentives</p> <ul style="list-style-type: none"> • Property purchase • Land swaps • Transferable development rights • Tax/rate incentives • Relocation subsidies <p>Disincentives</p> <ul style="list-style-type: none"> • Ineligible for insurance or response assistance to re-build after extreme events 	<p>Transfer risk via</p> <ul style="list-style-type: none"> • Insurance retreat, resulting in reduced property values and eventual sensitive land use decline • Offsetting losses by sharing or spreading the costs post-event, and providing compensation that

	<ul style="list-style-type: none"> • Prohibition of hard protection structures • Strategic withdrawal of infrastructure • Extinguishment of existing use rights 		may support relocation to other sites
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Challenges to Implementing Managed Retreat

Despite the benefits of managed retreat, its social and economic costs are often significant barriers to implementation, particularly when dealing with existing development. Managed retreat of private property can be plagued with challenges, which may vary according to resourcing, levels of risk and citizen engagement, cultural ties, political will, local leadership, agency, and institutional frameworks (Sipe & Vella, 2014). The following section pulls together insights from international literature to summarize fundamental challenges for managed retreat.

Economic Challenges

In developed countries, where experience of managed retreat is greatest (Zhu, Linham & Nicholls, 2010), existing use rights and fee simple tenure create an expectation of permanent use of land, which is not necessarily guaranteed. The changing nature of land is often ignored, and managed retreat is made difficult by increasing property values, particularly in coastal areas where risk is not immediate. Moreover, managed retreat strategies may diminish property values over time, as may hazard experience and insurance retreat. Further, if relocation is required, it can be financially expensive to cover the loss of properties, demolition or relocation of structures, and site rehabilitation (Bardsley & Niven, 2013). The economic burden of managed retreat varies depending on how it is spread across property owners, local ratepayers, taxpayers, and insurance companies. Public costs of managed retreat will inevitably include project management, risk assessment, strategic planning, community engagement, and replacement of stormwater, roads, infrastructure, and public amenities. Depending on the funding model, these costs could also extend to replacement of existing utility services, land rehabilitation, and restoration, as well as property acquisition and provision, and private relocation or demolition of structures. In certain circumstances, such as under long-term, staged, managed retreat at the coast, public costs may be limited to the bare minimum. However, financial incentives or compensation are often expected where managed retreat is enforced in the short-term. There are likely to be property value and scalar thresholds where compensatory managed retreat schemes are not viable, but in places where it is uneconomical to maintain hard defenses compared to the value of assets at risk, managed retreat may be economically advantageous in the long-term (Cooper, 2003). Although managed retreat is likely to provide benefits to the wider community and future generations, in comparison to mitigation measures which allow continuation of the status quo, there are potentially higher costs for individual property owners who are directly affected (Cooper & McKenna 2008).

Managed retreat is often contingent upon national or state government funding support. Cost allocation and moral hazard issues may arise if governments fund the retreat of private property (Gibbs, 2016). Taxes or rates generated by property and business owners who have assets that are not at risk compensate property owners who, in some cases, willingly made risky investments. However, risk information is not always certain or widely available, or risk may have increased over time. Rulleau, Rey-Valette, and Clément (2016, p. 371) conducted a study in the South of France, finding that a principal of national solidarity dominated the case for

funding managed retreat and “significantly and positively affected preferences in favor of a realignment policy.” In Australia, Waters and Barnett (2017, p. 13) investigated public perceptions to climate change adaptation, also finding that, in opposition to the broad international focus on the shift from government to governance, there is a strong preference for government regulation (to varying degrees) “to ensure fairness and consistency across space and time... [and] a collective spatial imaginary of governing in which the national government provides information and meets most of the costs of adaptation, and where local governments engage in planning and regulation.” Further developing on these public cost allocation perceptions, Rulleau et al. (2016, p. 373) argued that principles of justice and solidarity are important to inform compensation models, with the two main determinants of preferences and willingness to pay based on “a notion of solidarity towards those who have longest been owners and are most attached to their property and a notion of responsibility towards those who were informed of the risks.” Principles of responsibility and national government support are also considered relevant by Cooper and McKenna (2007), Paavola & Adger (2006), and Boston and Lawrence (2018) who also recognize principles of need and capacity to pay, to support equitable burden sharing.

In circumstances where incentivized or compensated managed retreat is beyond the means of authorities and existing development is facing slow-onset risks, legislation prohibiting the sale, transfer, or redevelopment of exposed properties can avoid significant financial burden on the wider taxable community (Gibbs, 2016). However, to enable consistent funding and policy models, nations must debate ethical principles to inform managed retreat funding, including the trade-offs among notions such as solidarity, responsibility, and moral hazard. Ethical values and social justice are context dependent, and a fundamental concern for funding managed retreat is addressing spatial and temporal inequalities to present and future people and ecosystems (O’Hare & White, 2017). While the economic costs of managed retreat are likely to be significant, particularly as the scale of retreat increases, they should be considered as relative to the costs of the status quo, and so should not be automatically prohibitive. Koslov (2016) argued that there are ways to make managed retreat more financially viable, citing precedent in the United States for voters supporting tax increases to pay for buyouts and recognizing major government subsidies to the fossil fuel industry “which arguably should be on the hook for at least some of the costs of climate-induced relocation” (Koslov, 2016, p. 364).

In nations where private property rights aren’t the norm, managed retreat (or more commonly termed, resettlement) may have fewer economic barriers (Zhu, Linham & Nicholls, 2010). For example, in Shangnan County, China, local governments were responsible for processing household registration transfer and allocating land or homesteads for migrants, avoiding what was perceived as an expensive and difficult process for individuals (Lei, Finlayson, Thwaites, & Shi, 2015). In this case, a financial subsidy and procedural assistance were enabling (Lei et al., 2015). However, resettlement has proven a disruptive process that can also result in maladaptation (Lei et al., 2015), requiring protection of livelihoods for migrants (as well as those who choose not to or are unable to relocate), including secure tenure, services, income generating activities, and social networks (Tadgell et al., 2018).

Socio-Political-Cultural Challenges

Socio-political resistance to managed retreat is somewhat derived from ideological concerns that correlate retreat with defeat in a military sense, or as “giving up” to nature, indicating human weakness (Koslov, 2016). The desire for economic growth also contributes to a negative perception toward managed retreat, as it reduces potential for increased development opportunities, which are often at the center of social aspirations and political influence. Successful managed retreat strategies may protect people and assets from harm, but the review

demonstrates how they must also be socially and politically acceptable to be effective. Low acceptability has seen managed retreat policies rejected internationally, for example in Byron Bay, the South Coast of the Fleurieu Peninsula, and Port Macquarie, in Australia; Urenui, Waihi Beach, and Kapiti Coast, in New Zealand; and in Fairbourne, Wales, to name just a few. The evolution of managed retreat terminology in the United Kingdom also illustrates the difficulty in gaining political acceptance (Rupp-Armstrong & Nicholls, 2007). In the case of Port Macquarie, managed retreat was identified as a potential option to reduce erosion risk via purchase of affected properties (Harman et al., 2015). Yet, even the possibility of managed retreat catalyzed significant community angst and unease, with overwhelming submissions in support of hard and soft protection measures (Harman et al., 2015). While this does help demonstrate that hard protection is more socially acceptable, they do create path dependencies that are hard to veer from and can increase residual risk. Such pathways make transformational resilience (a fundamental restructure of state or system) extremely difficult, and can decrease the feasibility of adaptive strategies such as managed retreat (Wenger, 2015).

The analysis of Hino et al. (2017), of 27 international case studies, reveals that managed retreat strategies are fundamentally shaped by the relationships and interactions of the parties involved. Applying parties' motivations for managed retreat to structure a conceptual model, Hino et al. (2017) mapped case studies on horizontal and vertical continuums according to residents' willingness to move and the implementing party's motivation to support it. The framework created four quadrants representing different managed retreat interventions; *mutual agreement*, with residents initiating retreat and governing authorities supporting it; *greater good*, where managed retreat is imposed on residents and broader society benefits; *hunkered down*, where residents do not support retreat and broader societal benefits are minimal; and *self-reliance*, where residents support managed retreat but have no implementation assistance. This framework highlights the importance of community empowerment and agency, political will, and institutional support, with mutual agreement cases being more likely to succeed (for the example of Grantham, Australia—see Okada, Haynes, Bird, van den Honert, & King, 2014; Sipe & Vella, 2014).

Place Attachment

Managed retreat is likely to result in disruption to attachment of place, sense of identity, and social networks, producing a sense of loss for affected residents. Burley, Jenkins, Laska, and Davis (2007) considered that places and spaces are socially constructed manifestations of “the self,” and that change in these arenas (whether organic or enforced) will catalyze forms of psychological reactions. Rey-Valette, Rulleau, Hellequin, Meur-Férec, and Flanquart (2015) noted that, even if compensated, some coastal communities will resist managed retreat due to attachment to the home and seaside amenities. Where managed retreat interventions fail to recognize how communities relate to their spaces and places, opposition frequently occurs. As such, respect and understanding of local knowledge and experience can reduce conflict between officials, experts, and communities. Psychological connection to place is considered important as communities are more likely to be involved in a managed retreat process if there is attachment to place and an understanding that the place is under threat (Rey-Valette et al., 2015). However, what is necessary for managed retreat to occur is actually *place-detachment*, where the community individually and collectively understand and negotiate the future consequences of remaining in the affected place, and slowly loosen ties to the present attachment and form new attachments in safer locations (Agyeman, Devine-Wright, & Prange, 2009). This process of detachment is significant for managed retreat, where people work towards future stability through current change, loosening and creating new ties to place and space. Place attachment is a barrier to implementing managed retreat, further research is needed

to understand the social, cultural, economic, and physical enablers of detachment to place and space, and the ways in which interventions can nurture detachment without provoking resistance to change (Agyeman et al., 2009). For example, associated with detachment is the need for *re-attachment* to a new locality, requiring careful social and cultural integration, as well as adequate land, infrastructure and service provision, and economic opportunity. Entering a new community may be as, or even more, traumatic than “leaving home.” Furthermore, unlike migration and displacement, with managed retreat there will be no option of “returning home,” as in many circumstances, the land will no longer exist, or land use activities will be prohibited in perpetuity.

Ineffective Community Engagement

Managed retreat interventions have a higher likelihood of being accepted when they are interpreted by those involved in and affected by it as a process that is fair, transparent, and inclusive (Agyeman et al., 2009; Vandenbeld, 2013). Esteves (2013) highlighted a lack of effective community engagement as a significant limitation, and past failures demonstrate the pitfalls of flawed science communication, “late” or weak community engagement, and inconsistent strategies, resulting in public contestation, litigation, and diminished institutional trust (as occurred, for example, in Kapiti, Byron Bay, and Fairbourne).

Community engagement is vital in managing retreat to achieve understanding and acceptance of the science that determines the risk, trust in authorities managing the process, and fundamentally, to facilitate robust decision making. In New Zealand, there is some expectation of the ability to “select” or “vote” on managed retreat, where it has an impact on private property. This is not dissimilar to international experience and application of voluntary retreat. Shishmaref, a 400 year-old Eskimo village approved a plan to relocate inland, and most residents were not opposed to it. Agyeman et al. (2009) posited that this may be because all 650 villagers were engaged over a long period of time and were given the opportunity to democratically approve the plan by two-thirds majority vote. As such, community engagement should be designed in a way that allows people to understand the risks and consider the range of options before decisions are made. It is imperative that directly affected people and the wider community are thoroughly engaged in decision making processes from the beginning. It should also be noted that managed retreat not only affects private property owners, but the form, use, and sustainability of local spaces, with potential for additional publicly owned land. Rey-Valette et al. (2015) noted that especially at the coast, all resource users are affected, including tourists and residents from neighboring non-coastal districts. The perceptions, expectations, and benefits of managed retreat for these users, who may find managed retreat more favorable than affected property owners, must also be considered for options analysis, cost allocation, and implementation.

Meaningful engagement involves and empowers people—rather than simply seeking their views, building relationships and trust are key factors of successful engagement (Roca & Villares, 2012; Smith, Leitch, & Thomsen, 2016). Where people feel that their interests are being considered and have opportunities to share knowledge, values, and ideas, there is much greater opportunity for positive relationships between stakeholders and acceptance of the outcomes (Roca & Villares, 2012). In New Zealand, for instance, the central Government’s New Zealand Coastal Hazards and Climate Change Guidance for Local Government 2017 draws on the work of Hurlbert and Gupta (2015) to determine when collaboration or empowerment should be applied (as opposed to merely “informing” people). The guidance expects that high impacts in the short-term, which trigger a large level of behavioral change and result in a potentially significant disruption to society, correlate to a need to collaborate with and empower communities. Managed retreat, a significant social change with high

impacts on people and communities lies within this remit. Consistent treatment and early, enduring, and meaningful engagement are also vital to managed retreat strategies, but for many, managed retreat can be difficult to imagine. Therefore, scenario planning tools and “serious games” (Flood et al., 2018) may benefit communities coming to terms with what it might mean for them, and may build certainty and understanding of the process. As part of effective engagement, communities and managing authorities attempting anticipatory retreat must also determine the point at which retreat is required before coping thresholds or carrying capacities are met. That said, achieving consensus on triggers can be difficult as risk tolerability is subjective, and vulnerability may differ between individuals.

Institutional Deficits

Institutional barriers can de-rail managed retreat strategies or make it near impossible to raise it as a possibility in the first instance. In New Zealand, arbitrary government interventions, national regulatory framework voids, hard protection legacies, and poor funding support have resulted in nationwide inconsistencies, and unsupported local managed retreat strategies have generated public contestation and distrust in local government (Hanna, White, & Glavovic, 2018). A process of policy learning is underway, but weak national frameworks and direction, legal uncertainty, and a lack of funding support hinder fair management of risk. When dealing with managed retreat and the significant implications it brings, these institutional barriers breed public distrust in authorities, confusion, fatigue, distress, and anger, particularly when financial investments and livelihoods depend on confidence in the future. Where a legitimation or trust deficit exists, it “undermines public support and commitment to programs of change and ultimately undermines the ability of power-holders to mobilize resources and promote co-operation and partnership” (Stoker, 1998, p. 20). To be effective, managed retreat requires national policy frameworks that clearly outline the roles and responsibilities of institutions, direct policy making, and outline mechanisms to facilitate, strategically plan, and assist in the funding of managed retreat depending on the contextual and ethical principles deemed appropriate.

These barriers have also been raised by Bronen and Chapin (2013) and Bronen (2015) in research of four Alaskan native communities threatened by climate-induced impacts. To overcome these institutional challenges, Bronen (2015) proposed an adaptive governance framework to allow the mechanisms, funding release, and multi-level governance arrangements required for preventive managed retreat, supported by community-based social-ecological monitoring and assessment processes to build community empowerment, allow protection of human rights, and enable transparent decision making. Young (2018) posits that prevailing government approaches to managed retreat have been “non-committal wait-and-see” arrangements, leading citizens to assume that property purchase will be applied if necessary.

Managed retreat is an umbrella term, which can be applied using a range of mechanisms to manage various hazards, scales, and levels of risk, hence there will not be a one-size fits all solution. However, the best outcome will be coordinated and robust. Without a supporting framework and mechanisms available for undertaking managed retreat, local authorities or individuals acting alone will not deliver fair or efficient outcomes, and uncertainty will remain. In the meantime, strong local leadership is required to help overcome these barriers (Bronen & Chapin, 2013; Sipe & Vella, 2014).

Discussion

Table 2 summarizes key socio-political-cultural, environmental, economic, and institutional enablers and challenges of managed retreat raised in the international literature. While these are loosely grouped into four primary categories that drive and deter the implementation of managed retreat, the issues should be seen as integrated. For example, institutional issues are related to wider issues of trust within communities.

Table 2. Socio-Political-Cultural, Environmental, Economic, and Institutional Enablers and Challenges for Managed Retreat

Enablers	Challenges	Sources
<i>Socio-Political-Cultural</i>		Abel et al., 2011; Agyeman et al., 2009; Bardsley & Niven, 2013; DEFRA, 2002; Esteves, 2013; Fazeya et al., 2016; Fried, 1963; Hayward, 2008; Hino et al., 2017; Hogg, Kingham, Wilson, & Ardagh, 2016; Lei et al., 2015; Zhu, Linham & Nicholls, 2010, 2012; Mortreux & Barnett, 2009; Rey-Valette et al., 2015; Ruppert, 2008; Ryan et al., 2012; Townsend & Pethick, 2002; Usamah & Haynes, 2012; Wenger, 2015
Prevention of risk to life and assets	May be viewed unfavorably by affected property owners	
Can increase adaptive capacity & resilience of communities	Disruption to attachment of place, culture, and sense of identity	
Opportunity for collaboration between community and decision makers	May result in community division (for receiving and retreating communities) and political contention	
Protection of wider community values (access, amenity, reduced maintenance/emergency management costs)	May result in loss of social networks, distress, feelings of lost control and may increase vulnerability	
Can be a flexible option for managing uncertainty, action may not be required until a certain threshold is met (e.g., DAPP)	Existing use rights and the expectation of permanent use of land when land may not be permanent. This is worsened by increasing property values, particularly in coastal areas, however this may eventually be mitigated by insurance retreat.	
Reduction of social discomfort from emergency	People directly affected may have a sense of loss	
Efficient strategy for managing risk with potential for anticipatory risk reduction	Visible and hidden power within the community can influence decisions (e.g., wealthy property owners exerting political pressure to protect the coast)	
	Cultural heritage	
	Incremental protection measures can decrease the feasibility of retreat—path dependency, escalator effect, safe development paradox, levee effect	
	Ineffective community engagement	
	Livelihood incompatibilities or inadequacies	
<i>Environmental</i>		Bardsley & Niven, 2013; DEFRA, 2002; Zhu, Linham & Nicholls, 2010; McNamara & Jacot
Protection of environmental and amenity values, including carbon sequestration benefits of wetlands (managed realignment)	Abandonment/relocation resulting in low-quality environment if restoration is not staged and adequately funded, or the	

Prevention of coastal squeeze and habitat loss	institutional enablers are not in place	<i>des Combes, 2015; Sipe & Vella, 2014</i>
Nearby, available land for resettlement	Lack of accessible/useable land for resettlement	
Enablers	Challenges	Sources
<i>Economic</i>		<i>Abel et al., 2011; Bardsley & Niven, 2013; Cooper, 2003; Cooper & McKenna, 2008; DEFRA, 2002; Gibbs, 2016; Hino et al., 2017; Linham & Nicholls, 2012; Roca & Villares, 2012; Townend & Pethick, 2002</i>
One-off cost with limited maintenance expenditure	Potentially significant costs; risk assessment, strategic planning, stakeholder and community engagement, collaboration, relocation, funding, restoration and resettlement	
Reduction of future emergency management and hard protection expenses	Potentially higher risk management costs for individual property owners directly affected than other methods (but long-term, public benefits)	
	Potential for reduced property values, equity, and market uncertainty	
	Authorities who re-zone land to afford space for ecosystems may become liable for consequent decrease in property values, even if risks to properties are expected to increase on that land in future	
	Numbers of coastal residents and value of properties at risk may have thresholds where retreat becomes less likely	
	Moral hazard and precedent risks of incentivization	
<i>Institutional</i>		<i>Bronen, 2015; Bronen & Chapin, 2013; Zhu, Linham & Nicholls, 2010; McNamara & Jacot des Combes, 2015; Sipe & Vella, 2014</i>
Local leadership	Insufficient national or state government funding support	
Flexible, adaptive governance	Absent or deficient institutional frameworks resulting in fragmentation, inaction, inconsistencies and inequity	
Organizational support (i.e., Department of Fisheries support in Vunidogoloa village, Fiji)		

The challenges and enablers listed may not be present in all cases, and local contexts will bring unique hurdles and co-benefits to consider, but as managed retreat essentially imposes trade-offs between immediate costs and those in the future, there will inevitably be contestation. The review emphasizes that to achieve anticipatory, or even reactive, managed retreat is not easy as it requires a strategic, integrated plan where communities are thoroughly engaged, empowered, and supported to detach from their places of habitation. Managed retreat is generally centered on the exposure and vulnerability of people, but it also requires attention toward the infrastructure and utilities required to service settlements, public lands, and ecosystems at risk, and growth and development patterns to plan for changes in land use and

to allocate new space for relocation. Integrated, interdisciplinary planning is crucial at city, regional, and national scales for strategic adaptation, not exclusive to managed retreat.

The data also highlights how the use of integrated, spatial planning for disaster risk reduction and climate change adaptation, and in particular, managed retreat has not yet been fully realized. As managed retreat is essentially a restructure of development and land use patterns to redesign unsustainable settlements, it could be more strongly integrated into spatial plans devised to re-evaluate and improve land use patterns, infrastructure, and spatial design, to maintain and restore ecological buffers, and even to consider opportunities for resilient housing or to provide new opportunities for relocation that works to foster adaptive capacity of people and communities. Finding resettlement land is difficult for individuals, let alone the possible relocation of entire settlements. Under most retreat scenarios, careful planning will also need to occur to enable integration of relocating and receiving populations. Relocation must not be a burden on receiving communities and the essential infrastructure and services required to service the existing population. In addition, “when the concerns of the host community are not adequately considered, this is likely to result in resentment” (Vanclay, 2017, p. 15). This may present itself in a range of ways, with severe circumstances of hostility or violence causing further trauma, and delays for those resettled to feel established and safe in their new home (Vanclay, 2017).

The challenges emphasize how, not only are authorities in need of institutional frameworks to direct and enable strategically planned, managed retreat at local scales, but national and even international direction is important too. Managed retreat is a broad strategy, applicable across space and time. It will need to (and is beginning to) occur in anticipation of, and in response to the slow-onset effects of climate change, as well as sudden-onset disasters. In addition to this, climate change mitigation projects may require changes in land uses—for example, to expand forests for carbon sequestration or build adaptive capacity by creating new water reservoirs (Ionesco, Mokhnacheva, & Gemenne, 2017). Therefore, the remit of managed retreat may go beyond climate change adaptation to mitigation as well. Managed realignment schemes with significant ecological restoration projects attached are already assisting in this goal, but as a co-benefit rather than a single driving force.

While it has proven to be a disruptive process in the past, lessons from development resettlement will be useful to inform significant managed retreat strategies. These insights include the need for specific human rights principles implemented throughout planning processes, and realized in the outcomes of resettlement actions, driven by collaboration between communities, governments, and civil society organizations (van der Ploeg & Vanclay, 2017). A recurring issue is that managed retreat interventions must: be concerned with the rights of affected people and communities; act in fairness, with transparency and accountability; ensure meaningful, robust engagement and active involvement of affected people; allow for self-determination; and anticipate compensation from loss of or detriment to income, assets, culture, heritage, services, and social capital. Livelihood restoration programs must be in place to support and empower people and communities in securing a suitable location and ensuring the foundation for sustainable livelihoods that are environmentally, culturally, socially, and economically viable and desirable. Without a focus on human rights, past conflicts, and human adversity caused by involuntary resettlement are likely to endure (van der Ploeg & Vanclay, 2017).

In practice, managed retreat tends to be perceived as a last resort, rather than a viable adaptation strategy (Burkett, 2015). Yet, as environments become progressively uninhabitable, anticipatory managed retreat can provide useful opportunities in comparison to reactive actions. The limits of protectionism and accommodation mean that managed retreat is inevitable and necessary in some cases. Planning ahead and making provision for both sending and receiving communities is therefore a growing imperative. Local desire to relocate is useful

for its implementation, however managed retreat also requires institutional and funding support to be effective. Further research is required in a number of areas, but particularly with regard to understanding the acceptability of managed retreat mechanisms, public preferences towards the level of intervention by governing bodies, rights to self-determination, and the ethical principles and funding models appropriate to different managed retreat(s). Beyond information, regulation, incentives, and risk transfer, there is also space for change in the way property rights are delivered in perpetuity, and a need to manage property valuations so that they reflect the transient, risky nature of susceptible environments.

Conclusion

Managed retreat crosses multiple disciplines and faces many challenges, but these should not overshadow its potential to adapt unsustainable land use patterns and retain natural capital, underpinned by a focus on respecting and working with, rather than against nature. Nonetheless, managed retreat remains complex and brings significant social and economic costs that require strategic planning, timely and effective community engagement, robust risk and socio-economic analyses, institutional frameworks, funding support, and local leadership.

While theoretical arguments for managed retreat continue to emerge, in practice it remains troubled by a lack of direction to guide and fund strategic decision making, ineffective community engagement, inconsistent policies, social and political rejection, and significant upfront costs, particularly those associated with land acquisition interventions. Managed retreat is not the “easy” answer, hence it is often considered a last resort; however, this only continues the trend of bias towards the present, at the cost of future species, and human populations who must maintain alternatives such as protection works, or respond reactively to system failures (White & Haughton, 2017).

Significant questions remain in determining when managed retreat is appropriate, which mechanisms to use, and how should governments best intervene. There is also a lack of understanding regarding which funding principles are socially acceptable (which is likely to differ across scalar and temporal thresholds), and how spatial planning may integrate managed retreat into broader growth (and decline), infrastructure provision, land use, and ecosystem management plans. Spanning from local to international scales, lessons from practice do show potential in providing guidance and propagate new opportunities to balance social, economic, and environmental trade-offs. What is clear from current practice is that early, collaborative engagement with affected people, communities, and political actors is beneficial to empowering communities to adapt with change, overcome place attachment, and develop locally nuanced and innovative solutions. However, without enabling institutional frameworks and support in place, interventions may not be fully realized. To be effective, managed retreat must progress from its position of political “last resort,” to a viable strategy that is considered and facilitated alongside the traditional risk management regime.

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