REVIEW

Reframing strategic, managed retreat for transformative climate adaptation

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Human societies will transform to address climate change and other stressors. How they choose to transform will depend on what societal values they prioritize. Managed retreat can play a powerful role in expanding the range of possible futures that transformation could achieve and in articulating the values that shape those futures. Consideration of retreat raises tensions about what losses are unacceptable and what aspects of societies are maintained, purposefully altered, or allowed to change unaided. Here we integrate research on retreat, transformational adaptation, climate damages and losses, and design and decision support to chart a roadmap for strategic, managed retreat. At its core, this roadmap requires a fundamental reconceptualization of what it means for retreat to be strategic and managed. The questions raised are relevant to adaptation science and societies far beyond the remit of retreat.

Evolving social norms, technologies, and economies will create futures that fundamentally differ from our world today. Climate change constrains the range of possible futures and affects the level of transformation societies will experience. Extreme humid heat (1), limited freshwater availability (2), wildfire (3–5), sea level rise, and flooding (6–10), among other climate-exacerbated hazards, threaten relationships among people and places, the persistence of human settlements, and even human survivability in some locations. The extent of climate change, and how societies respond, will depend on which risks people decide not to tolerate and which values—and whose—are prioritized (11–14).

Numerous adaptation actions—often categorized as resistance, accommodation, avoidance, retreat, and advance (7, 15)—can address climate risks. Resistance reduces exposure by armoring or keeping hazards at bay, whereas advance builds into hazardous areas (e.g., through land reclamation). Accommodation measures such as infrastructure elevation or warning systems reduce sensitivity to hazards. Avoidance limits new development in hazardous locations, and retreat removes people and assets from hazardous places after development has occurred. Each adaptation action represents a distinct value-laden decision about what to preserve, purposefully change, or allow to change unguided (16). Retreat has often been viewed as a failure to adapt or considered only when all other options are exhausted (12, 17–21). But this conceptualization ignores lessons from numerous disciplines drawing on

a long history of human movement and limits adaptation researchers and decision-makers in preparing for a broad range of futures.

The term "retreat" refers both to autonomous relocations and to coordinated movements supported by governments and organizations at multiple scales (17, 22, 23). Relatively modern social institutions, such as borders and policies designed for a climate assumed to be unchanging, now hinder rapid relocations (14, 24–26), but throughout history, people have moved and retreated in response to climate (27, 28). Retreat occurs today in the face of relatively moderate climate change (17, 23, 29, 30). In the future, retreat will be a component of many climate-driven transformations that involve fundamental shifts in societies. Whether as a minor element or a substantial factor in portfolios of response, history suggests that movement will occur (Fig. 1).

Retreat can be more effective at reducing risk, more socially equitable, and more economically efficient if it is managed and strategic—i.e., if it is designed and executed in ways that promote broader societal goals (30, 31). Serious consideration of retreat, even if subsequently rejected, can help communities articulate why remaining in place is a core value, what costs they are able to endure or what opportunities they can forego to remain in place, and what responses sustainably support individual and community priorities (7, 14, 32). Achieving this potential requires a reconceptualization of retreat, not as failure to adapt or last resort but as an adaptive option that can proactively support social values through a plurality of specific measures.

In this Review, we draw on empirical and theoretical literature to argue that societies will adapt more effectively and equitably—as evaluated against the values of individuals, communities, and societies—if they consider the potential role of strategic, managed retreat. We (i) outline ways in which strategic, managed retreat diverges from past practice; (ii) reframe

two often-posed questions to demonstrate how a reconceptualization of retreat drives a value-informed and radically interdisciplinary adaptation science agenda; and (iii) discuss the role of retreat in creating adaptation visions and pathways that bridge the chasms between the present and long-term resilience.

Strategic, managed retreat differs from past practice

To date, managed retreat projects have been largely incremental, minor adjustments implemented using a handful of policy tools, guided by a limited set of social values, and small scale in their contributions to climate change adaptation (15, 23, 33). For example, in the United States, voluntary home buyouts have helped ~45,000 families move out of flood-prone homes over the past 30 years; this represents a tiny fraction of the millions at risk and is fewer than the number of homes experiencing repeat flood damage and the number of new homes built in floodplains. Buyout programs often affect just a handful of households within a flood-prone community, while simultaneously raising equity concerns about who is offered buyouts and how they are treated in the process of relocating (19). Around the world, retreat programs frequently involve relatively few people, compared with the number of people at risk, and are disconnected from larger strategies for climate adaptation (17).

Although many retreat programs have reduced risk exposure and economic losses, their effects on broader individual and social goals are contested (7, 14, 21, 29). "Successful" retreat will be defined differently by diverse stakeholders and may change over time and across contexts (11, 13, 34). Nevertheless, the literature offers key areas for improvement, which we review in turn below: (i) proactively envisioning managed retreat as a feature of climate-driven transformations, (ii) engaging a diversity of approaches for strategic retreat, and (iii) coordinating across disciplinary and governance silos to connect societal priorities. We posit that these changes have not occurred because addressing them requires difficult systemic and structural adjustments and because retreat has not yet been adequately prioritized despite substantial efforts of some communities, practitioners, and researchers to overcome the barriers. Nevertheless, there are reasons to believe changes may yet occur.

Retreat as a feature of transformations

Retreat has figured into disaster risk management and adaptation portfolios largely as a deprioritized, politically perilous option (7, 15, 20, 32, 33), in part because the motivation in most cases has been to avoid transformation: to enable people to continue living where and how they have in the past. Yet as climate conditions shift outside the bounds of

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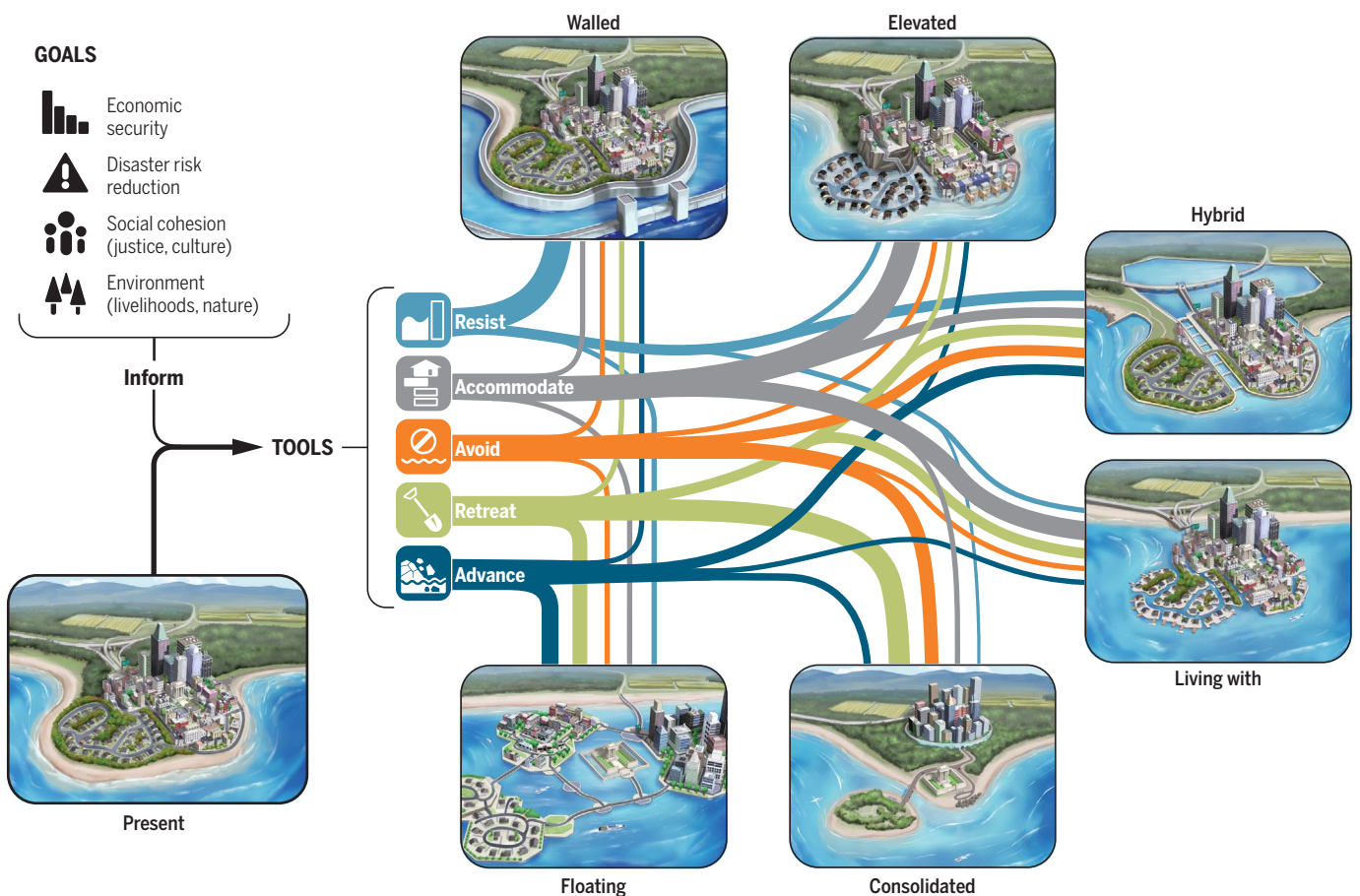
Fig. 1. Holistic pathways of climate transformation. (Bottom left) A hypothetical present-day settlement (dense city, suburban and periurban communities, and rural areas). (Right) Six possible futures. Adaptive pathways between the present day and the future will be shaped by climate risks, limits to adaptation, and societal goals. Strategic, managed retreat (green) will have some role in each future, along with other categories of response. The degree of retreat varies across scenarios (e.g., removal of a few structures to create space for retention ponds and pumping in the hybrid scenario or large-scale relocations in the consolidated or floating scenario). A decision not to engage in strategic, managed retreat complicates the pursuit of these futures and may eliminate certain futures as options.

historical human experience, the need for transformational adaptation that fundamentally alters systems will likely increase (*5, 9, 11, 14, 35, 36*). Societies will shape how they transform and what tools they use, depending on the evolving values they prioritize (e.g., economic growth, social justice, environmental health, cultural heritage, and public safety).

Most climate-driven transformations will involve some degree of retreat in combination with measures to resist, accommodate, avoid, or advance (Fig. 1) (*19, 22, 35*). New or cheaper technologies may keep high waters out of coastal settlements for longer periods (*9, 37*), enable inhabitants of wildland-urban interfaces to better live with fire threat (*38*), or support outdoor work in locations where extreme humid heat exceeds human physiological tolerances (*1*). However, even where technological solutions work and predominate—in creating floating settlements, encircling cities with storm or fire barriers, or enclosing workers in chilled suits—some retreat will occur to create room for technological adaptations or to increase their potential (Fig. 1). In other

transformative futures, retreat is likely to become a core component rather than a supporting element. The extent and nature of retreat will depend on progress, breakthroughs, and constraints that shape myriad forms of adaptation (*7*).

The diversity of strategic retreat

Retreat to date has taken multiple forms, such as mandatory resettlements of communities and home buyouts post-disaster (*17, 23, 29, 39*), but managed retreat can take even more forms (*14, 22, 28, 30*) such as restrictions on rebuilding in hazardous locations; setbacks limiting development near areas prone to erosion, flooding, or wildfire; downzoning encouraging decreases in asset exposure over time; easements supporting ecological conservation and risk reduction; or community relocation (*40, 41*). Empirical studies on managed retreat note the need to tailor programs to local contexts (*7, 15, 29*), and increasing the types of retreat drawn upon is essential for adaptation that effectively manages current, much less future, climate risks (*42*).

Practitioners are experimenting with retreat policies, and retreat in the future will likely combine social, financial, legal, engineering, and conservation innovations (Fig. 1) (*7, 19, 22, 41*). Future retreat could involve more frequent or bigger applications of existing practices (*36*). For example, future strategic retreat could be extremely targeted to small, specific locations that create space for systems of retention ponds and pumps or downsize asset exposure in fire-prone locations (*7, 14, 38*). Practitioners and communities are already finding innovative ways to use small parcels of open land created through targeted buyouts (*43*). In some cases, strategic retreat might shift the core of a city, preserving the general location of the city while relocating neighborhoods. In others, such a rolling shift may be of limited utility, and strategic retreat might entail massive deployments, such as moving an entire city or converting roadways into lakes and canals, removing farms and shifting into aquaculture, or restricting power lines to a more limited set of fire-proofed enclosures (*36*). Managed retreat projects have helped people move as

individuals by providing job training to facilitate migration, have relocated whole communities by constructing new towns nearby, and have developed new communities for people arriving from multiple locations (*30, 44*). Programs have attempted to promote social justice by prioritizing voluntary choices and social support. They have aimed to maintain cultural heritage through relocation or documentation of cultural resources or to use newly open land effectively by establishing community gardens or endangered species habitats. Future managed retreat programs may engage these aims even more directly; for example, by addressing historic forced resettlements through reparations, preserving cultural sites, or facilitating ecosystem migration.

How retreat occurs will depend on the nature of the hazards to which it responds, their intensities, return periods, temporal and geographical trends, and the potential for other adaptation options to reduce risk (*1, 4, 6, 38*). For example, wildfires affect communities through both fire and smoke, which threaten people in varying ways at differing geographic scales and with variable recurrence frequencies. Because most retreat to date has occurred in response to flooding, future retreat in response to a wider range of threats is likely to inspire novel forms and innovations (*9, 14, 38, 45*). Future retreat may also increasingly result from slower-onset trends, such as continuing subsidence, recurrent high-tide flooding, permafrost melt, groundwater salinization, or desertification (*2, 7, 19*). Proactive retreat, planned before slow-onset changes severely threaten lives, livelihoods, and other things people value, is likely to be more effective and to reduce the psychological, sociocultural, and implementation burdens of retreat (*19, 28, 42*).

Coordination across silos

Retreat to date has focused on reducing risks and economic losses, responding to disaster impacts, or creating habitat—values defined by a narrow set of stakeholders and often disconnected from other societal objectives such as cultural or community cohesion, livelihoods, ecosystem health, and housing security (*21, 29*). In the future, strategic, managed retreat must attend to a more extensive set of goals and stakeholders, from localities where retreat occurs to regional, national, and international communities involved in funding and implementation (*17, 19, 33*). In practice, achieving strategic retreat has been very difficult. Most managed retreat programs have lacked a holistic plan (*17, 39*), and retreat efforts with strategic plans have been stymied by systemic implementation barriers and siloed governance systems (*23*). In rare cases such as the relocation of small towns away from flood-prone rivers or coastlines, retreat has promoted

more holistic values, providing hope that strategic retreat could become more common.

Climate adaptation in unambiguous forms such as managed retreat raises multitudes of existing societal challenges, such as inadequate housing, energy access, or immigration law (*17, 19, 28*). For example, perhaps more than any other adaptation strategy, retreat has generated debate and discord related to equity (*7, 14, 21, 28*). Categories of concerns include the locations where governments make (or do not make) managed retreat available; failures to recognize historic injustices shaping current conditions and stressors; lack of transparency, fairness, or voice; retreat processes or outcomes compromising the capabilities of people; or insufficient consideration of ecosystems (*17, 29, 39, 46, 47*). Equity considerations will be magnified as increasing climate change disproportionately affects low-income regions, marginalized populations, and future generations that have contributed little to cumulative greenhouse gas emissions and may less readily finance and pursue responses (*25, 34, 35, 48, 49*). Equitable approaches to retreat require considering social justice in both the outcomes and process of retreat: Transformations are inherently political, and without deliberate approaches, they risk exacerbating historic wrongs (*7, 12, 25, 29, 48, 50*). Future strategic retreat could be a proactive process for addressing inequities; opening up opportunities; grappling with climate losses; and holistically supporting health, well-being, livelihoods, and security (*12, 13*). For example, over decades and centuries, governments in many regions have displaced marginalized communities, including Indigenous peoples and racialized groups, and have failed to equitably serve them; where these communities now face immense climate risks, strategic retreat led by these communities could be a proactive process for recognition of historic injustices, reparations, and reconciliation that supports social healing. Achieving equitable, strategic retreat requires innovations, learning, and substantial deviations from the past.

Multiple levels and agencies of government, the private sector, and individuals all must reckon with the impacts and losses associated with climate change and adaptation (*7, 13, 24, 42, 45, 51*). Retreat, as for much of adaptation, cannot be siloed (*14, 21, 25*), yet mainstreaming into ongoing decision-making involves pervasive, structural challenges. Sociopolitical and cultural barriers to transformative adaptation may be particularly salient for retreat because of its stark deviations from prevalent norms. Major efforts are underway to address these challenges for adaptation generally—by building capacity, increasing funding, raising awareness, and developing decision-making tools—and these efforts to

facilitate equitable, transformational adaptation will make strategic, managed retreat easier (though not easy). Reforms are more likely to facilitate strategic, managed retreat if it is seen as a viable or even desirable adaptation option, rather than a fate to be avoided (*19, 21, 28, 51*), but how communities and decision-makers might be inspired to reconceptualize retreat is an open question. In the following sections, we make two suggestions: (i) changing the way retreat is researched and evaluated to enable clearer comparisons to its alternatives and complements; and (ii) engaging in bold, long-term visioning of adaptation futures to help stakeholders identify which aspects of the present should be preserved and which should be actively changed, perhaps through retreat.

Adaptation science for strategic, managed retreat

Research on managed retreat has not adequately answered numerous questions that are critical in reshaping how and why retreat is considered by practitioners and communities. We argue that greater progress can be made by reframing existing questions, by asking a broader set of questions, and by engaging with a range of connected disciplines. To demonstrate, we reframe two questions often asked about retreat and identify several unanswered questions that need greater attention.

Where will climate retreat occur?

The question of where retreat will occur as a result of climate change is frequently posed. This underscores a crucial but often underappreciated distinction: Unmanaged retreat as a default that occurs when other options are absent is fundamentally different from managed retreat as multiple tools strategically deployed in pursuit of desired futures. There are at least two important reframings of the question: (i) Where will resources be allocated to prevent unmanaged retreat? and (ii) Where will strategic, managed climate retreat occur?

Adaptation resources are finite, and decisions about where to resist, accommodate, advance, and manage retreat are therefore also choices about where to allow unmanaged retreat (Fig. 1). Mapping where unmanaged retreat will occur requires numerous assumptions about the types and magnitudes of climate impacts that cause relocation, capacities to invest in alternative adaptations, future development patterns, and local goals. Estimates of sea level rise displacement by 2100 range from 88 million to 1.4 billion people, depending on whether the estimate assumes that all people in low-elevation coastal areas will be affected or only people in areas permanently inundated or historically flooded (*14*). These numbers could be substantially lower, depending on how much shoreline armoring or infrastructure elevation occurs and how effective

those strategies prove. One analysis estimated that, for 13% of the world's coastline, armoring is an economically robust adaptation strategy to minimize total costs of sea level rise, and for 65% of the global coastline, allowing unmanaged retreat minimizes total costs (7, 35). The geographic disparities are notable, with shoreline armoring primarily in high-income countries and unmanaged retreat economically implied for small islands and rural coastlines. Notably, these estimates assume that retreat requires little or no public expenditure and occurs when resources are not available for other options.

Attempting to estimate where retreat will occur on the basis of where other adaptation strategies will not occur frames these approaches as alternatives when, in reality, retreat intermingles with armoring, accommodation, and advance measures (15, 39). Even in places where armoring is the economically robust decision, retreat is likely to occur to create space for infrastructure or floodplains (Fig. 1). Moreover, individual and community decisions about whether to remain or retreat are not exclusively driven by risk exposure. People decide to relocate for many reasons: e.g., risk perceptions, place attachment, social norms and networks, livelihoods, institutional responses, resources and capabilities, and opportunities available elsewhere (14, 18, 26, 32, 52). To identify a place where retreat will or "should" occur purely on the basis of exposure to hazards or economic efficiency is to erase the lived experiences and factors central to relocation (12). In fact, identifying places where retreat "should" happen may inspire public resistance or investments to avoid retreat in those very places (47). Instead, asking where unmanaged retreat can be prevented creates agency: It highlights that unmanaged retreat can be limited through deployment of in situ adaptations and managed retreat.

The second way to reframe the question of where retreat will occur is even more difficult: "Where will strategic, managed retreat occur?" or, to be more precise, "Where and in what forms will managed retreat support futures desired by the populations involved?" Answers to this question require understanding of the full set of societal goals to be pursued and the transformative pathways that could promote them (Fig. 1). These determinants of strategic, managed retreat, both priorities and processes, cannot be readily mapped or deduced at large scales to provide probabilistic, geographically explicit estimates. Even if they could, the ways in which people relate to place, their aspirations, and the values they ascribe to mobility or stability will be dynamic through time and sometimes contradictory (13, 53). Assessing future needs for managed retreat requires integration of compound-hazards climate science; studies of dynamic socioeconomic development and migration; techno-economic evaluation of engineering solutions; and analysis of sociocultural, psychological, political, institutional, and financial factors central to the viability—or lack thereof—of protecting societies in place as climate risks increase (14, 37, 52). Where retreat will occur is a beguilingly simple question that requires advances across adaptation-relevant disciplines and adaptation options.

Is retreat beneficial or harmful?

Climate-related transformations and adaptation are all about change, which involves losses and gains, sometimes for different groups (e.g., creating winners and losers) and sometimes both simultaneously for a given person, household, or community (12). In this regard, retreat is exceptional but not unique among adaptation approaches. Dialogues and debate about relocation, however, frequently hang on whether retreat is a benefit or a harm: whether or not it was a "success." The more powerful framing is, first, whether the benefits or harms of managed retreat are greater or lesser than for other actions and, second, how retreat can be managed to maximize benefits and minimize harms.

This reframing explicitly acknowledges that retreat intrinsically creates opportunities and losses simultaneously (12). Compassionate, proactive implementation of managed retreat must therefore recognize the incommensurability of some losses and the importance of engagement with them (13, 42). Insights from the emerging science of climate change loss underscore the importance of recognizing the changing relationships among people and with places, the necessary and dynamic trade-offs among valued things, and the contested power relations that prioritize some people's losses over others' (7, 13, 52).

Crucially, transformation affects many intangible values—such as sense of belonging or identity, shared histories and heritage, or the intrinsic value of biodiversity—which are difficult, if not impossible, to measure and therefore generally overlooked (52). A situated approach to retreat reflects context and the narratives through which needs and nonsubstitutability are explored, and it is implemented by or with those who are affected (28, 44, 48, 50). For example, through community partnerships and citizen science, threatened heritage sites can be monitored, records created, and losses acknowledged and memorialized (54). Intentionally loosening attachments with a given place and context, choosing elements to retain, and proactively forming new relationships in another location can reduce pain and enable people to work through loss and grief in adaptation and retreat (12, 13, 51).

The methods by which decisions to retreat are made, at individual or collective levels, are important. Having control over their destinies is essential in people's identities and relationships with place, yet further research is necessary to understand how retreat decisions are best made and how power dynamics affect how retreat conversations should be initiated—for example, with governments offering retreat or as grassroots efforts emerging from community requests (14, 19, 33, 46, 51). Voluntariness of retreat is often assumed to maximize benefits and minimize losses, but empirical work is needed to explore exactly what voluntariness entails. Is it enough that retreat is the best financial option available? Or does voluntariness require something more, and if more, what? Should a person suffering solastalgia [the pain of watching an environment change and degrade (55)] and unable to reclaim the old community be helped to move? Whether households and communities have the resources and capabilities to adapt in place, retreat on their own, or adjust to a new location may also influence perceptions and limits of voluntariness (12, 21, 29, 49). Numerous communities are likely to require assistance in managing strategic retreat, so who should pay, and how should decision-makers prioritize allocation of resources? Research is also essential for enduring questions of how to address historical injustices that have shaped who is at risk from current and future climate-related hazards (25, 29, 48).

Concerns about retreat, as both beneficial and harmful, should be asked about every type of adaptation, especially transformational adaptations that fundamentally alter systems. Academic evaluations of managed retreat tend to consider a fuller range of harms and benefits—e.g., how retreat affects identity and connection to place, agency, equity, and property rights, leading to harms even where flood risk has been reduced (7, 14, 15, 21, 28, 29, 37)—than government agencies' evaluations of managed retreat and other adaptation options. Protective structures, such as levees, can alter place attachment when they fundamentally change a community's layout or reduce access to open spaces, but it is relatively uncommon to consider the implications of in situ adaptation for place attachment (52). Remaining in a place that experiences environmental degradation can cause painful emotions as relationships with that place are altered (55). Practitioners frequently ask how retreat can be financed, and the same question applies to how in situ adaptation approaches will be financed, who will pay, and whether the costs and benefits are equitably distributed. Comparing the answers for retreat with those for other adaptation approaches provides much more information than asking about retreat in isolation. Future research can help communities and decision-makers consider retreat more carefully by comparing opportunities and losses across the full portfolio of options, including resistance,

Fig. 2. Future visions for retreat in transformational adaptation. (Left) A floating city; (right) urban green space. These images illustrate the creativity that can be applied in imagining different relationships between people and places. We are not advocating for either of these visions, specifically. Rather, creatively imagining futures beyond the constraints of the present in equitable, participatory processes can enable new ideas, individually and collectively, about how to stay in place or how to preserve communal practices, cultural well-being, and other valued attributes even where retreat or other climate-driven transformations occur.

accommodation, advance, and avoidance as well as retreat (*15*).

Other unanswered questions

Retreat, as for most transformational adaptations, forces consideration of difficult questions that have far-reaching implications for numerous disciplines and areas of adaptation practice. How can agency and mental health be maintained under climate-driven transformations (*12–14, 42, 52*)? What engineering innovations will be needed to support infrastructure that is permanently inundated, sited on melting ground, or repeatedly exposed to wildfire? What are the economics of retreating versus staying in place, where mismatched incentives or risk perceptions lead to market failures? What are the legal implications of a country that loses its territory (*14*)? How might local jurisdictions be merged? Supporting societal deployments of strategic, managed retreat requires advances in adaptation science and should draw from the vanguard of political science, economics, migration studies, sociology, and cultural heritage studies, among other fields.

Implications for adaptation now

Most climate adaptation to date has been small scale and short term, involving minor modifications to standard practices such as planting crops earlier in the season or building floodwalls to address storms (*56*). The level of ambition and innovation in adaptation falls substantially short of the challenges posed by current, much less future, climate risks (*7, 56*).

Designing bold, innovative, and adequate adaptation strategies, including retreat and other transformational options, involves both motivating visions (i.e., future states that represent the goals and values of the people adapting) and pathways (i.e., series of steps that connect present actions with possible futures). Incorporating retreat into these visions and pathways will require widespread implementation of acknowledged best practices from adaptation science and innovations from other disciplines.

Adaptation visions

Adaptation science can tap bolder visions and pathways by implementing lessons learned from design-thinking and planning and by integrating insights from a range of social sciences and the arts. Methods such as scenario analysis and iterative, participatory deliberations geared toward decision-making under deep uncertainty (*7, 19, 45, 57*) are frequently used in adaptation, although not consistently in accordance with acknowledged best practices. For example, planning activities that consider how the future may unfold too often constrain the range of futures being considered or do not represent the values of the participants. Approaches from architecture, design, environmental engineering, anthropology, archaeology, climate fiction, futurism, and security assessments, which are increasingly considering climate change, can offer rigorous, structured ways to question assumptions, generate creative ideas, and explore opportunities in future visions or scenarios (Fig. 2)

(*58–62*). Disciplines central to social change can help people trust and use climate science in envisioning the futures they want to pursue through adaptation. Artists visualize the consequences of climate change through installations, such as lights representing future tidemarks (*60*). Climate fiction imagines dystopian and utopian visions of the future and pathways leading to beneficial change (*61*). Divides drawn between science and the arts blur when scientists consider future social conditions (e.g., the shared socioeconomic pathways) and related narratives (*62*).

Creating visions of the future to guide adaptation should not be a top-down process. Effective processes can reduce political polarization, involve marginalized groups, address historic wrongs, situate local concerns within broader contexts, highlight interactions and interdependencies within and across systems, and collaboratively construct future visions (*7, 33*). Expanding the option set depends fundamentally on participant goals, and the process of eliciting and constructing these goals is inherently interactive. Listening across political differences or documenting a community's reality and valued attributes through photos or videos, as well as future storylines, heritage discussions, and participatory mapping, can be (and in some cases is being) used to create space for conversations about losses and damages, justice, culture, and curative and adaptive approaches for the future (*19, 45, 54*). Dialogue in such interactions supports open-ended consideration of what is valued and

how creative options could preserve relationships under change and support the collective good (*13*). Iterative consideration of goals is crucial because visions for the future evolve through time, including through the process of adaptation itself (*53*).

Dynamic adaptation pathways

Articulating and pursuing visions can lead to harms as well as beneficial outcomes (*53*), and top-down or overly techno-optimistic visions, in particular, may continue colonialist, autocratic, or otherwise unjust traditions. Some of these concerns can be mitigated through participatory visioning processes. Other concerns, especially those about unintended harms, may be addressed by developing flexible pathways: steps bridging the present and future that allow for and even encourage revision (*7*, *45*, *57*). Current choices create path dependence and potential maladaptation, equally through conversations that are not happening right now as through those that are (*20*, *22*). For example, conversations about how to help shrinking settlements thrive or how to address historic injustices may be crucial for future adaptation responses, and these options may be limited because such discussions are currently inhibited by social or political risks. Key features of effective adaptation processes and decision support therefore involve: (i) flexible, diverse responses that can be adjusted through time; (ii) active monitoring and evaluation to guide necessary changes along the way; (iii) integration of local, Indigenous, scientific, and other scholarly knowledge to assess context-specific risks; and (iv) meaningful public deliberation to promote learning, consensus building, conflict resolution, and fair and just responses (*7*, *20*, *24*, *28*, *45*, *48*, *50*, *57*).

Retreat in adaptation visions and pathways

Retreat offers a valuable set of tools for both creating visions for adaptation (i.e., articulating goals and values) and navigating flexible pathways. Creative processes such as design often begin by considering wide ranges of possible options before narrowing down, encouraging participants to question assumptions and ignore limitations (*59*). Many large-scale adaptation strategies will involve managed retreat, as either a central feature or a minor but critical component, so refusing to consider managed retreat as a possibility limits the options available and the range of possible outcomes (Fig. 1). Thinking outside the box requires a willingness to embrace change, or at least to think critically about which elements of the current system should be maintained and which should be purposefully altered. Retreat—even discussion of the potential for retreat—engages some of these difficult conversations.

Our goal in authoring this article is not to suggest that managed retreat will be the optimal adaptation in any given place, but to encourage serious consideration of retreat in climate-related transformations: to better understand why remaining in place is a core value; which valued relationships should be maintained in adaptation portfolios; and what costs communities are able or willing to endure, or what opportunities they can forego, to remain in place. Early conversations about managed retreat—and where, when, and why its use could be considered acceptable (or not)—substantially increase the likelihood that future climate retreat will promote societal goals.

Adaptation visions have the potential to be bold, in pursuit of futures prepared for climate shocks that promote social justice, improve quality of life, and foster stronger relationships between peoples and between people and nature. Retreat is controversial because it challenges the status quo and has potential to cause major and inequitable losses. Conversely, retreat has enormous potential to inform adaptation precisely because it challenges the status quo, raises difficult questions about justice, forces people to confront the inevitability of change, and encourages people to make mindful choices about trade-offs and losses in the futures they pursue. Strategic, managed retreat may not be implemented in many places. Yet bringing it into adaptation conversations now, despite (or even because of) its complexities, creates better chances of long-term, sustainable well-being under intensifying climate risks.

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