



# The role of law in adapting to climate change

Jan McDonald\*

Legal institutions and instruments will play an important role in climate change adaptation, along with technological, managerial, and behavioral strategies. Law can facilitate adaptation, using regulation to reduce exposure or sensitivity to climate hazards, establishing the legal architecture for new market mechanisms, and funding arrangements for adaptation costs and liability for climate impacts. It can also ensure the accountability of adaptation decision making and addressing some of the social justice dimensions of adaptation. Yet there are also characteristics of legal institutions, processes, and principles that may impede adaptation, including by creating compensable property rights that hinder new regulation. There are several characteristics of climate change and associated impacts that will make law-making for adaptation uniquely challenging. These include high levels of cascading uncertainty, irreversibility, the context-specificity of impacts, the long delay between emissions and impacts, and the interaction between climate change impacts and other environmental, social, and economic stressors. Laws dealing with substantive climate impacts may be appropriate and necessary in some cases, but the broader challenge for law-makers is to make legal processes and instruments more adaptive and responsive to change itself. © 2011 John Wiley & Sons, Ltd. *WIREs Clim Change* 2011 2 283–295 DOI: 10.1002/wcc.96

## INTRODUCTION

Climate change is creating a world of triage, best guesses, and shifting sands, and the sooner we start adapting legal regimes to these new regulatory and management realities, the sooner we can marshal energy and resources into actions that will help humans, species, and ecosystems cope with the changes that are coming (Ref 1, p 16).

Legal institutions are an important element of a society's capacity to adapt to social, environmental, and economic change. The responsiveness, robustness, and accountability of a legal system—encompassing formal and informal rules and the agencies responsible for their design and implementation—will influence the timeliness and effectiveness of climate change adaptation strategies. A well-functioning legal regime can provide stability in times of rapid change and uncertainty, a principled foundation from which to affect needed reforms, and

a mechanism by which to safeguard the rights of disadvantaged individuals and groups in the design and implementation of adaptation options.

Many events trigger the need for legal reform: sudden shocks such as the September 11 attacks or extreme natural disaster may expose inadequacies in existing administrative and legal frameworks. Such events may demand immediate responses that strain the capacity of existing structures and processes. Environmental degradation caused by creeping or incremental threats may provide more time for legal reform to occur but our limited success in combating these threats does not suggest that longer planning horizons will necessarily result in better frameworks.

The impacts of climate change are likely to be mixed: some are likely to occur swiftly and without warning while others will be experienced incrementally. This combination of sudden shocks and creeping change, compounded by the scale and unpredictability of irreversible consequences of climate change, distinguish it from other environmental, social, and economic stressors to which we have previously responded (Ref 2, p 17 and p 23). Adapting to the impacts of climate change in the

\*Correspondence to: jan.mcdonald@griffith.edu.au

Griffith School of Environment, Griffith University, Gold Coast, Queensland, Australia

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long term therefore poses a unique and unprecedented challenge for law.

Climate change requires us to locate legal interventions within a suite of appropriate adaptation strategies, to identify and evaluate both technological adaptation solutions and critical attitudinal and behavioral changes. For each impact, the evaluation of adaptation options will involve assessment of technological, economic, political, and psychosocial change, and a re-think of legal and policy arrangements across a wide range of sectors.

There has been a great deal of attention given to legal interventions to drive mitigation initiatives. This includes negotiations to improve the international legal regime for emissions reductions, reforms to national laws aimed at implementing mandatory renewable energy and energy efficiency targets, emissions trading schemes, and carbon taxes. It also includes legal actions brought by civilians or non-government organizations against carbon intensive industries, aimed at imposing liability on those companies for climate change impacts.<sup>a,3–6</sup> In contrast to the interest in laws supporting mitigation initiatives, very little work has examined the systems of law and governance that will be required to deliver adaptation policies.<sup>b,7–14</sup>

This article outlines the potential role of law in preparing us for a climate-adapted future. It explores how law can be used to effect planned adaptation or to encourage autonomous adaptation,<sup>c,15</sup> and the design requirements of a legal framework for addressing the peculiar challenges posed by climate change risks. *Law as Facilitator of Adaptation* discusses the ways in which law can facilitate adaptation, using regulation to reduce exposure or sensitivity to climate hazards, establishing the legal architecture for new market mechanisms and funding arrangements for adaptation costs, and requiring compensation or imposing liability for climate impacts. *Law as Barrier to Adaptation* then identifies the ways in which legal processes and principles may impede adaptation, including by creating compensable property rights and rights to privacy. The importance of legal frameworks in ensuring the accountability of adaptation decision making and respecting human rights is outlined in *Ensuring Accountability and Equity in Adaptation Decision Making*. Having suggested various roles for law in adapting to climate change, *Designing Adaptive Laws* then identifies the features of climate change impacts that pose particular challenges for legal design, and suggests how current approaches must change to accommodate them. Many of these features are common to other environmental, public health, or social stressors, but their combination makes climate

adaptation a unique legal challenge. The last section presents the conclusions, arguing that laws will be required that explicitly address climate change impacts and that are themselves adaptive to potentially rapid changes in climatic and environmental conditions. Improving the adaptiveness of laws requires us to improve the processes of law-making to ensure that different voices and values inform regulatory design, a commitment to the incorporation of adaptive management principles and renewed attention to the principles of good environmental governance in legal processes.

## LAW AS FACILITATOR OF ADAPTATION

Adaptation will demand a combination of technological, behavioral, attitudinal, economic, and management changes. Many of these will occur as broader social processes, rather than the result of deliberate government policy or judicial intervention. Nonetheless, law will be an essential vehicle for implementing adaptation policy across a range of sector and fields. Law confers rights and imposes obligations; provides the architecture for regulating behavior and activities, including the performance of government functions; establishes the framework for public participation in government decision making; and arbitrates and resolves disputes between the state and private individual and between individuals. In countries with Common Law traditions, law derives from statutes passed by the legislative arm of government—typically an elected Parliament or Congress. Where no statute has been enacted, the relevant law is distilled from key principles articulated by courts resolving particular disputes. These principles are built on, refined and clarified by successive courts resolving cases over many years. In Civil Law systems, it is assumed that the law is codified, so the role of courts is merely to interpret and apply those codified laws. In some countries, customary or Islamic law continues to apply, typically alongside more Western systems. Whatever policies are adopted to promote adaptation, most will require a legal foundation in order to clarify obligations, powers, and entitlements. Law will provide the basis for policies aimed at changing behavior to promote adaptation actions before damage is suffered and a framework for responding to losses after the event.

## Regulation to Reduce Exposure or Sensitivity to Climate Risks

A range of regulatory instruments can help prevent, minimize, or recover from the damage caused by

an extreme weather event or incremental climatic change. Measures include traditional ‘command-and-control’ instruments such as prohibitions, licensing schemes, and planning tools. These are likely to be introduced in the regulatory regimes for a wide range of sectors and activities, including land use planning, biodiversity conservation, natural resource management, and emergency management, and are unlikely to be described as ‘adaptation laws’ as such.<sup>d</sup>

For many, land use planning will be the most effective tool by which to reduce exposure and sensitivity to extreme weather events.<sup>16,17</sup> Urban planning and coastal management can limit development in flood-, bushfire-, and erosion-prone areas. Where the nature of climate risks allows for longer term behavioral change, it can employ ‘soft’ planning tools, such as information to prospective purchasers about the risks to their properties. More interventionist measures, such as zoning exposed locations to prohibit or restrict new development and stipulating the performance criteria or other requirements (such as demountability of structures) for development to proceed, may be required in areas exposed to greater, shorter-term risks.

Planning frameworks in many countries already require development agencies to consider the way in which climate change might affect a proposed development or are developing guidelines to do so.<sup>e</sup> These requirements herald a variation on traditional environmental impact assessment (EIA) law. The historical focus of pre-approval EIA requirements was to embed into decision making the likely environmental impacts of the development. Planning for adaptation requires the decision maker to consider how the *environment* (rising sea levels, more extreme weather events, etc.) might cause adverse impacts on the *development*, and whether the economic costs of these impacts on future owners of the development can be justified.<sup>f</sup> Where approval agencies must comply with statutory planning instruments, the more detail with which climate change impacts are specified in these documents, the more likely courts will be to require their consideration in decision making.<sup>g</sup>

Land use planning will be an especially potent tool to reduce exposure to climate impacts in ‘greenfields’ sites that are not currently developed, or whose level of development reduces overall vulnerability. It is more limited in locations that are already heavily urbanized. Adaptation of existing buildings, networks, systems, and institutions will involve either relocation, through policies of ‘planned retreat’, or retrofitting. Retrofitting might entail technological or engineered solutions (such as sea

walls, flood-proofing, etc.) or re-engineering of the processes and tools for managing and governing these places. The long life of existing infrastructure will affect the technological and economic feasibility of adaptation options. Unless they are heavily funded, retreat strategies will involve significant interference with property rights and are therefore likely to be challenged through political and legal avenues (Ref 1, p 61). Such policies will also require careful design and implementation to avoid a flurry of maladaptive development in the lead-up to changed regulations and zonings, as has occurred with other changes to property entitlements such as native vegetation clearing laws.<sup>18</sup>

Other forms of regulation will be needed to respond to the projected impacts of climate change. Where pricing mechanisms are disfavored on equity grounds, restrictions on domestic water consumption can have a dramatic impact on demand-side management.<sup>b,19</sup> Similar restrictions may be required to deal with electricity demand spikes during heatwaves.

Frameworks for natural resource management and biodiversity conservation may require more fundamental reform (Ref 2, p 17 and p 23). The capacity of natural systems to adapt autonomously is unlikely to keep pace with the speed of change expected under climate change and will be constrained by a range of external factors, such as habitat fragmentation and degradation, over-harvesting or exploitation, competition or predation.<sup>20</sup> At the very least, traditional approaches to biodiversity conservation will require strengthening, to focus more on private land as wildlife corridors or buffers zones, control of invasive species and regulation of land-uses that are incompatible with conservation goals (Ref 14, p 18 and p 19, Ref 20, p 61, Ref 21, and the references cited therein).

### Supporting Economic Instruments and Incentives for Adaptation

Economic instruments such as taxes, tradeable permit schemes, and financial or administrative incentives for desirable behavior have replaced prohibition in many modern regulatory contexts.<sup>22–25</sup> The sectoral regimes that must incorporate climate change adaptation are likely to adopt a similar suite of measures, depending on the industry’s particular regulatory and economic setting. For example, developers may be encouraged to adopt adaptation-friendly building forms through reduced development charges and rates in places and the criteria for such incentives will need to be formalized. Where incentives are used

to promote such adaptation measures as insulation, the installation of water efficient appliances, permit or quota buy-back schemes, or local rates rebates, rules will be needed to govern their availability. There are also less obvious examples of laws to provide incentives for adaptation. Modifying the tax regime, for example, could encourage specified adaptation retrofits of rental housing, by designating them tax-deductible maintenance expenses rather than depreciable capital expenditures. Given that a disproportionate number of poor people are forced to live in rental accommodation, incentives to improve the quality of such housing stock may reduce the differential impacts of climate change on such groups<sup>i</sup> (Refs 26–30, Ref 31, p 14 and p 15, and the references cited therein, Ref 32).

### Legal Frameworks for Funding Adaptation

Where regulation mandates particular anticipatory adaptation actions, a funding mechanism may be required for some initiatives to offset the disproportionate economic burden on disadvantaged individuals or groups (Ref 28, p 93). Local authorities are particularly concerned that a heavy burden falls on them because of their role in planning, flood mitigation, coastal management, and management of local infrastructure assets.<sup>j</sup> Local-level political factors may disincline local authorities from passing these costs on to developers and rate payers, which reduces the likelihood that measures will be introduced at all.

If anticipatory or preventive adaptation strategies are not implemented or prove to be ineffective, the impacts of climate change may result in death or injury, or property damage and associated economic losses. Legal principles will provide the framework through which such losses are distributed across society. It is highly likely that claims for compensation will be made in the future by individuals and businesses that have suffered loss as a result of extreme weather events. Scenarios can be imagined in which claims are made against property developers, local authorities, emergency services agencies, and the owners and operators of critical infrastructure such as electricity, telecommunications, and water supply. The risks of potential exposure to liability for the failure of or damage to new building works or infrastructure projects can be managed through appropriate contractual allocation of responsibility and liability. Contractual provisions could also define or elucidate the application in a climate change context of terms that might permit avoidance of the contract, such as *'force majeure'*.

In the absence of a contractual relationship between the parties or the allocation of responsibility

in contract, the framework governing liability for compensation claims will be derived from Common Law principles based on the tort of negligence or their codified equivalents in countries with Civil Law systems. Aside from the high cost and lengthy delays in legal proceedings, negligence claims will be an unsatisfactory default mechanism for resolving questions of liability. This is because individual legal actions can only ever resolve liability issues in respect of the particular case before the court. A finding of negligence in one situation does not bind courts considering different circumstances, or courts in different jurisdictions considering very similar circumstances. The *ad hoc* nature of litigation thus makes it incapable of providing general clarification of who should be liable, in respect of what decisions or actions, at what time. Leaving such matters to the courts will exacerbate existing social injustices because only the wealthy will be able to sue.

The higher the number of individuals, businesses, and properties affected by climate change impacts, the greater the need for a statutory liability, compensation regime, or other funding mechanism that can provide a consistent and predictable approach to financing repairs, retrofit, or relocation.<sup>k</sup> Clarity would be achieved by legislating to remove all rights to sue for climate change impacts, provided there was no scope for legal argument about whether the claim was based on a climate change impact. While such an approach may provide clarity, however, removing all rights to sue could work a serious injustice against individuals whose property, assets, or health is adversely affected by climate change impacts because of another party's actions or decision.

One mechanism that retains access to compensation while avoiding the cost and uncertainty of litigation could involve the introduction of a mandatory insurance scheme that required all properties to carry cover for natural hazards or something similar. A mandatory scheme would enlarge the insurance base, thereby reducing the risk of such cover for insurers and ensuring the availability of adequate funds. The design of such a requirement would need to minimize its potential for negative effects on the poor and the link between insurance and maladaptive behavior.<sup>l</sup> It is beyond the scope of this article to explore these issues in detail (Ref 21 and the references cited therein), but the need for legal reform in this area is only likely to increase in the decades ahead.

### LAW AS BARRIER TO ADAPTATION

Although law will be a critical tool for facilitating adaptive behaviors, it may also create an impediment

to both autonomous and planned adaptations. Regardless of intent, laws can undermine adaptation if they have the effect of discouraging positive strategies or behaviors. Such perversities need to be identified, then eliminated or reduced. The most obvious of these are Constitutional or other legal rights to compensation for a 'taking' or resumption of property, or a diminution in its productive uses. This may occur where adaptation planning seeks to avoid development or limit activities in hazardous locations. Legal duties to compensate will compound the technological and economic adaptation challenges created by the physical exposure.

The stultifying effect of legal rights or expectations for compensation is a familiar refrain in environmental and natural resource policy and regulation.<sup>m,33–36</sup> An expectation that the holders of development rights, water entitlements, or fishing or other resource harvesting quotas will be compensated for any loss of those rights has affected the design and operation of many law reform initiatives<sup>n</sup> (Ref 37, Ref 38, p 150 and p 151, Ref 39). Speaking of challenges experienced in the United States, Moser et al. note:

future options for managing these [coastal] growing risks are heavily influenced by past development and land use patterns, significantly constrained by existing coastal laws and regulations, and potentially affected by the expectations these have set among developers, residents, resource users, and businesses regarding their ability to live and do business along the coast (Ref 40, p 653, Ref 41).

The challenge will be in the balance between achieving essential adaptation outcomes, respecting existing property rights, and avoiding the creation of compensable rights under future regulatory schemes. Common Law concepts such as public nuisance and the United States' public trust and public necessity doctrines, and statutory solutions such as rolling easements may provide a mechanism by which to achieve this balance (Ref 1, pp. 61–63, Refs 42,43). In some cases, however, the payment of compensation may be the only way to achieve appropriate adaptation goals. In these circumstances, well-crafted laws will be required in order to define the individuals to whom or circumstances in which compensation is payable. As noted in the preceding discussion law can then facilitate adaptation once the political impediment—the decision to make compensation and the value of those payments—has been overcome.

Privacy laws may also operate as potential barriers to adaptation if they constrain the operation of early warning systems that depend on contacting

residents directly. Preventive public and community health campaigns aimed at vulnerable groups may also encounter logistical difficulties if personal data such as residents' age is not available to implementing agencies. Protection of private information is highly valued in many legal systems, but safeguards may need to be relaxed if they impinge on the effective operation of early warning systems.

## ENSURING ACCOUNTABILITY AND EQUITY IN ADAPTATION DECISION MAKING

The impacts of climate change are likely to trigger the operation of numerous legal powers and duties. These powers and duties may derive from laws governing a diverse array of policy domains, including public health, national security, emergency management, and environmental protection. Wherever adaptation policies and strategies require a legal intervention, the rules governing the processes of law-making and decision making will be relevant.

Emergency management laws, for example, provide the legal framework within which government responses to extreme weather events take place. Road closures, prohibitions on entry into or evacuation from flooded or fire-damaged areas, declarations of states of emergency, and the associated entitlement to disaster relief payments are all determined under the statutory authority of emergency services legislation. These laws need to provide an adequate foundation for the powers of emergency services agencies and personnel but they also need to minimize the risks of individual or system failure and ensure that powers are not open to abuse. Limits on power might be imposed by the legislation itself. They may also arise through the operation of common law principles of negligence which are considered and applied in legal proceedings, coronial inquiries, and Royal Commissions following natural disasters.<sup>o</sup>

Human rights laws will also provide an important check on the design and implementation of adaptation policies. It has already been noted that the impacts of climate change are likely to have more serious impacts on groups and communities that are disadvantaged by virtue of their socio-economic status, age, health, or geographic remoteness. This will occur on a global scale, as well as at the level of nation–state. International lawyers are already exploring the implications of the global phenomenon of climate refugees,<sup>44</sup> whereas domestically, adaptation policies will need to address the social justice implications of climate change and the laws that implement adaptation policies

must themselves minimize potential discrimination or social injustices. Both human rights and anti-discrimination legislation can help ensure that the design and operation of adaptation laws redresses inequality and does not exacerbate existing drivers of social and economic vulnerability (Ref 30, p 95, Table 4.2, Ref 45).

## DESIGNING ADAPTIVE LAWS

The preceding discussion has sought to illuminate the various roles for law in promoting societal adaptation to climate change. The impacts of climate change must inform the way in which laws are developed, revised, implemented, and enforced, to maximize the ability to cope with uncertainty and rapid change, and to minimize social inequities or injustice caused by the uneven effects of climate change. There are some important characteristics of the climate change problem that<sup>p</sup> (Ref 14, p 17, Ref 46) while not individually unique to climate change, in combination make it an unprecedented challenge to law that will influence the choice, design, and timing of adaptation policies and laws.

### Context-Specific Adaptation Laws

A central theme of climate adaptation literature is that climate change will have different effects in different places, because of climatic variation, topography, and the underlying resilience and adaptive capacity of affected ecosystems, communities industries, and individuals.<sup>26,29,47</sup> The effects are expected to be borne disproportionately by groups with existing social, economic or physical vulnerability, on a local, national, and global scale.<sup>45</sup> Legal measures will have to prioritize interventions for those most at need and not place undue burdens on those least equipped to bear them.<sup>q,48,49</sup>

The highly localized nature of climate impacts also means that adaptation responses must also be tailored to local conditions, including biophysical risks and the social, economic, institutional, regulatory, cultural, and psychological context.<sup>r,50,51</sup> Centralized legal strategies may address wider market failures, create economic incentives for adaptation, or provide uniformity or coordination that is necessary to minimize unfair distributive effects. But applying the principle of subsidiarity to adaptation policy and law,<sup>s</sup> the vast majority of measures will have to be designed, implemented, and enforced at the local scale, closest to where impacts are experienced and their effects must be minimized. Laws based on subsidiarity will either have to be differently

formulated for individual locations and need-groups, or will have to contain some level of built-in flexibility or discretion. The first option makes the law-making task onerous, expensive, and time consuming. The second approach fails to provide certainty or clarity: the exercise of discretion makes it hard for subjects to know how laws will be applied in advance and risks perceptions of arbitrariness or inconsistency even where such concerns may be tested through processes of judicial review. Although the differential treatment of individuals and enterprises depending on their location and personal or sectoral vulnerability makes good sense from an adaptation perspective, it is a poorer fit in legal systems that expect equality and even-handedness in the operation and application of laws.

### Improving Law-Making Processes to Handle Inherent Conflict and Tradeoffs

The goals of adaptation will depend on perceptions of risk<sup>52,53</sup> and the values of those making adaptation decisions. These values may be diverse and competing<sup>t</sup> (Ref 54, p 339, Refs 55,56). The capacity for adaptation solutions in one place or sector to constrain adaptation options elsewhere will require careful consideration of whose values and preferences are driving the strategy (Ref 54, p 338). Enhanced processes for adaptive law-making can help to reveal and minimize these conflicts and ensure the local relevance of adaptation laws. Options include formal integrated 'adaptation assessments'—a proactive rather than reactive version of environmental impact assessment, better intergovernmental coordination, or improved mechanisms of public participation.<sup>13,14</sup> Even with better use of participatory processes, however, adaptation choices and resulting laws will necessarily involve tradeoffs between competing interests and values. A level of contestation must be expected. In many cases, this will be resolved through political forces but some are likely to be subject to judicial dispute, highlighting the importance of law in ensuring the accountability of adaptation decision making.

### Approaches to Dealing with Pervasive Uncertainty

The extensive literature on the subject makes it almost trite to point out that adaptation policy and law must grapple with multiple layers of uncertainty.<sup>57,58</sup> There are many areas of regulation that must cope with uncertainty. The tension between short-term development needs and long-term-but-uncertain

environmental risks is a common feature of environmental regulation and sustainable development law.<sup>59,60</sup> But while uncertainty is common to environmental regulation, the multi-layered and cascading uncertainties presented by climate change and the magnitude of the potential impacts bring an unprecedented complexity that can cause regulatory paralysis and therefore demands closer consideration (Ref 46, p 10, Ref 47, p 719, Refs 2,14,61–64).

To the extent possible, adaptation law and policy should be based on the best available science, but law is not known for its swift response to new information and legal reforms often lag well-behind rapidly emerging science. A combination of laws with specific, measurable adaptation objectives and laws that can respond rapidly to new knowledge can reduce the problems of uncertainty.<sup>20,65–67</sup> Change that can be anticipated should be allowed for through measures that apply in increments, or that ratchet up as soon as monitoring of specified system indicators shows that a critical threshold or built-in trigger is reached.<sup>68</sup> For example, development approvals in coastal locations might be expressed as lasting only until inundation events reach a pre-set frequency or sea-level rise is measured at a certain level. For conservation planning, a reduced catch rate might apply to commercial fisheries automatically, without the need for legal amendment, once stock levels decline below pre-set thresholds.

Incorporating adaptive management principles into regulatory design can also contribute to more agile regimes.<sup>67,69</sup> The relevant features for regulatory design include the importance of not locking in optimistic assumptions about the future (e.g., by avoiding or limiting the creation of property rights), allowing for small incremental change where information is insufficient for longer term decisions, built-in monitoring and evaluation, and a system of reflexive response to lessons from earlier phases and new information (Ref 61, p 208 and p 209, Refs 68,70,71). For example, planning guidelines that consider the impacts projected for the asset life of particular forms of development and that allow for straightforward revision can accommodate incremental change. Statutory requirements of monitoring and review, explicit limits on rights to compensation when baseline conditions necessitate a change of management, and the statutory discretion to make dramatic changes to management strategies when new information comes to light will all assist. This will also demand culture shifts within implementing agencies that may resist admitting error in the choice of earlier strategies even where such error was understandable.

The logic of reflexive and iterative laws is inescapable for sectors where small incremental changes are possible (Ref 14, p 57 and the references cited therein). It is less helpful in dealing with system ‘surprises,’<sup>70</sup> and is also of limited assistance in making decisions over things that simply cannot be done incrementally. The siting and construction of new long-lived infrastructure, for example, may have to be decided based on best estimates from comprehensive risk assessment, with residual risks addressed through operation, maintenance, back-ups, and insurance.

### Revising Regulatory Schemes to Accommodate Inevitable and Potentially Irreversible Change

Closely connected to the issue of uncertainty, the fourth challenge for the design of climate adaptation laws is the need to account for the potential for irreversible effects.<sup>63</sup> Irreversibility is not a unique feature of climate change adaptation policy. Species extinction is irreversible regardless of whether it is caused by over-harvesting, pollution, predation, or climate change, all of which are the subject of traditional endangered species, resource management, or biodiversity conservation laws. The distinguishing feature of climate change is the scale and unpredictability of these threats and the absence of any historical analog (Ref 1, p 17 and p 23, Ref 2, p 29):

...[C]limate change does not present just another disturbance regime, the operations of which we can extrapolate from current ecological knowledge; rather, it will be the undoing of ecosystems as we know them (Ref 2, p 22).

For natural resource management and biodiversity conservation law, predictions of irreversible changes require a paradigm shift. Traditionally, the concept of ‘stationarity’ has underpinned legal and management approaches (Ref 1, p 15). As climate change alters the *status quo*, new policy goals will be needed that accept the inevitability of some change and seek to improve the robustness of ecosystems to ongoing change (Ref 20, p 15, Ref 2, pp. 18–23, Refs 1,72) Debate is already underway in biodiversity circles, for example, over whether to accept the inevitability of some species loss and move to a policy of limiting extinction or ‘ecological triage’ (Ref 1, p 39, Ref 73, p 160).

The ultimate goal of particular adaptation policies or interventions may therefore be hard to define, and promoting ‘adaptability’ *per se* rather than

attainment of a specified goal needs to become the over-arching regulatory objective. This creates particular challenges for legal and regulatory interventions that require clearly articulated objectives. In the same way that law-makers are reluctant to introduce measures with retrospective application, there is also a reluctance to introduce measures aimed at preventing or minimizing ill-defined harm to future generations, when such measures will impose serious immediate costs on local industries or communities (Ref 61, p 60). Although adaptive or adaptable laws are needed, it will be important to ensure that flexibility in regulatory objectives does not operate as an excuse to avoid onerous or difficult decisions (Ref 1, pp. 63–69).

If uncertainty demands an adaptive management approach to designing adaptation laws, the risk of irreversible consequences obliges us to adopt a far more precautionary approach. The precautionary principle has been incorporated into national and international public health and environmental laws for many years and is formulated (and implemented) in a range of ways.<sup>v</sup> The best known of these exhorts decision makers not to use the absence of full scientific consensus as an excuse for avoiding cost-effective measures to prevent a risk of serious or irreversible harm to human health or the environment.<sup>w</sup> This framing is often criticized as imposing no positive duty to take action to actively prevent irreversible harm. UNESCO have proposed an alternative formulation that imposes such a positive duty to act to avoid or diminish morally unacceptable harm that is scientifically plausible.<sup>74</sup> In an adaptation context, laws informed by the precautionary principle would take active steps now to instate comprehensive plans for ecosystems and species that we can reasonably anticipate will experience major impacts and actively reduce other stressors that will exacerbate climate change effects. There are currently no conservation laws that require this kind of anticipatory planning for how a species will fare under climate change.

The speed of change and the risks of stepwise or abrupt change will also pose challenges for law.<sup>75</sup> Strong institutions, including laws and enforcement agencies, provide valuable stability and consistency at times of change. But this stability can also mean a sluggish response to rapid change<sup>x</sup> (Ref 75, p 3). Ideally, laws should be designed with the possibility of abrupt change in mind, so that they can be self-adjusting, but this may be impractical in many cases for reasons outlined in previous sections. The alternative is to enhance our overall capacity to effect rapid radical legal reforms. Anti-terrorism measures introduced in the aftermath of the September 11

attacks in the United States might offer guidance on the necessary conditions for such reforms and the checks on power that must be observed in order to balance wider public good against individual rights and protections.<sup>76,77</sup>

## Legal Memory and the Long Tail of Climate Impacts

Current levels of atmospheric greenhouse gases have locked the earth's climate into a period of unavoidable warming.<sup>y</sup> Although the effects of this climate change commitment on weather patterns may still take a long time to be fully realized, the inevitability of those effects is why adaptation is so important. But this lag means that decision makers today must deal with a legacy of urban and built form, infrastructure, and institutions that were designed, located, or developed without regard to the possible impacts of climate change.

Law is often slow to respond to new or changing conditions and this will hamper anticipatory adaptation. In the right circumstances, courts have been willing to evaluate and attach liability to conduct from decades earlier, but they often take a conservative or cautious approach when extending old principles to novel circumstances, preferring such developments to be dealt with by elected legislatures.<sup>z</sup> Yet executive and legislative arms of government under pressure from affected industry groups may consider that they lack the political mandate to make significant change until the weight of scientific evidence demands it.<sup>61</sup>

Law has responded to problems with long-tail effects in the past, and we can learn from the successes and failures of these efforts.<sup>aa</sup> The regulation of asbestos, tobacco, pesticides, and industrial chemicals, as well as the past decade of debate over climate change mitigation policy, shows the difficulties of reversing past practices that might interfere with rights and powers that were created before these risks were fully understood.<sup>61</sup> The reluctance of governments to regulate these activities and the piecemeal approach to both regulation of ongoing activities and compensation for victims, even as the evidence of their long-term harmful consequences became overwhelming, are lessons in what climate adaptation initiatives should explicitly aim to avoid.

## Improving Legal Responses to Nonclimatic Stressors

The effects of a changing climate will compound and intensify existing climate variability and other stressors on our ecological, social, and economic

systems. Many of these stressors such as water scarcity and invasive species are already regulated, and the effective implementation of those regimes is likely to enhance system resilience to climate impacts as well.<sup>78</sup> This creates an opportunity for no-regrets adaptation strategies that can deliver significant environmental or social benefits regardless of the precise impacts of climate change (Ref 1, p 33 and p 54, Ref 79).

It would be a mistake, however, to underplay the significance of how climate change will exacerbate current threats and to assume that the existing legal and policy framework is equipped to handle such changes with minimal modification. Worldwide, current approaches to managing nonclimate stressors have failed to arrest the decline in ecosystem and natural resource health. In some cases, this is because the existing approaches have been inadequately implemented or resourced. For these, improved political commitment to implementation and funding will deliver better outcomes for both climate change adaptation and the substantive conservation natural resource management objective. But in other cases, the regulatory approach itself may require fundamental reform and redesign. Whether the barriers to effective management or conservation are poor implementation or poor regulatory design, merely boosting current efforts is unlikely to curb the additional pressures of climate change unless those barriers to implementation and effectiveness are identified and overcome.

## CONCLUSIONS

The adaptation imperative demands a range of interventions. While law may not be an end in itself, many planned adaptation strategies will have to be underpinned by strong legal foundations. For some sectors, it will be critical to mandate proactive adaptation measures or prohibit maladaptive activities, whereas the use of economic incentives may be more effective and equitable in others. The regulatory regimes for urban development, building design, resource management, and biodiversity conservation will all need different approaches to the consideration and incorporation of climate impacts. In addition, laws may be needed to regulate how individuals autonomously adapt to prevent indirect impacts on others.

The limitations of substantive adaptation laws suggest that energy may be better directed at improving the adaptiveness of existing laws. To play its part, law and law-making must become more agile in changing to meet new conditions. Existing laws must be closely scrutinized for their potential to limit or prevent adaptation. The design and development of new laws should be

informed by three principles. First, the processes of adaptation law-making need to provide a forum for diverse voices and values and explicitly address the social justice implications of climate change impacts, either through better public consultation or a new form of adaptation assessment process. Second, the application of adaptive management principles to regulatory design should allow for more precautionary decision making that allows for uncertainty and the risk of irreversible impacts. Third, basic principles of good environmental governance and sustainable development—precaution, public participation, polluter pays, proper valuation of resources, intra-generational, and inter-generational equity—should underpin the design of adaptation laws (Ref 68, p 27). Design and implementation of laws using these principles would yield benefits even in the absence of any climate change impacts.

The scale and abruptness of future climatic shifts may render even these approaches to law-making inadequate. Climate change may bring regime shifts that are without historical analog, and beyond current human or institutional experience. The key challenge then will be to ensure that the stability, predictability, and even-handedness that law and legal institutions afford do not hinder radical reform where it is needed.

## NOTES

<sup>a</sup>Legal actions in the United States involving actions for damages include: *Comer v Murphy Oil USA*, No. 1:05-CV-436 (S.D. Miss. 2006) in which property owners and residents affected by Cyclone Katrina are seeking damages from a major carbon emitter and *Native Village of Kivalina v Exxon Mobile Corp*, 08-CV-1138 (N.D. Cal. Feb. 2008). In *Kivalina*, the Court dismissed a claim by the governing body of an Alaskan Eskimo village for damages for the cost of relocating the village whose location on a small peninsula has become highly vulnerable.

<sup>b</sup>Early work includes Refs (1, 2, and 7–14).

<sup>c</sup>Autonomous adaptation, also referred to as spontaneous adaptation, is ‘Adaptation that does not constitute a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or *welfare* changes in *human systems*.’

<sup>d</sup>IPCC 2007a (Ref 50).

<sup>e</sup>In Australia, for example, New South Wales, Queensland, and Victoria have developed policy guidance for development agencies on how sea-level rise should be taken into account in development assessment decisions: *State Planning Policy Victorian Coastal Strategy*, 2008, *Ministerial Direction no. 13 and General Practice Note 2008*; *Managing coastal*

hazards and the coastal impacts of climate change, *Coastal Advisory Note: How to consider sea level rise along the Victorian Coast* (Department of Sustainability and Environment, 2008), *State Planning Policy Framework*, cl 15.08 (Managing coastal hazards and the coastal impacts of climate change), 2009; *Sea Level Rise Policy Statement* (NSW) 2010; *Coastal Planning Guideline: Adapting to Sea Level Rise* (NSW), 2010; *Draft State Coastal Management Plan* (Queensland) 2009.

<sup>f</sup>See, for example, the Australian cases of *Northcape Properties Pty Ltd v District Council of Yorke Peninsula* [2008] SASC 57; *Gippsland Coastal Board v South Gippsland Shire Council* [2008] VCAT 1545; *Ronchi and Anor v Wellington SC* [2009] VCAT 1642; *Elken Lane Pty Ltd v Casey CC* [2009] VCAT 1642; *Myers v South Gippsland* [2009] VCAT 1022; and *Taip v East Gippsland Shire Council* [2010] VCAT 1222.

<sup>g</sup>*Northcape*, above note (f); *Walker v Minister for Planning* [2007] NSWLEC 741; *Aldous v Greater Taree City Council* [2009] NSWLEC 17; and *Charles and Howard Pty Ltd v Redland Shire Council* (2007) 159 LGERA 349.

<sup>b</sup>The introduction of water restrictions reduced domestic water consumption by 43% from pre-drought consumption (QWC). See also QWC. *Media release: water use remains at world class levels* 17 July 2009, reporting that water consumption on the Gold Coast, where restrictions had been lifted, was 50% higher than for areas where restrictions were still in place.

<sup>i</sup>For discussion of the distributive and social justice dimensions of climate change impacts see Refs 26–32.

<sup>j</sup>The Australian Department of Climate Change notes that local government is ‘at the forefront of managing the impacts of climate change’. See [www.climatechange.gov.au/impacts/localgovernment/index.html](http://www.climatechange.gov.au/impacts/localgovernment/index.html) (Accessed August 18, 2008).

<sup>k</sup>The features of such a scheme are considered in more detail in Ref (9). Paying the price of adaptation: compensation for climate change impacts (Ref 21, Chapter 10).

<sup>l</sup>For example, by encouraging policyholders to rebuild in the same location in circumstances where relocation is preferable (Ref 1, p 51).

<sup>m</sup>The literature is extensive. Examples include Refs 32–35.

<sup>n</sup>For historical examples of compensation packages, see Ref 36; in respect of tree clearing, see Ref 37; and fisheries closures in the Great Barrier Reef Marine Park, see the final report of FERM (Ref 38).

<sup>o</sup>The legal actions and Royal Commissions into the 2003 Canberra and 2009 Victorian Bushfires afford

prime examples of the latter. See Ref 20 (Chapter 11), above note (i) pp 79–96, at p 95, Table 4.2.

<sup>p</sup>Desai and van der Sluijs<sup>45</sup> distinguished between a climate adaptation decision and a ‘climate-influenced’ decision.

<sup>q</sup>As with other challenges, there are models from which we can learn—the United States’ ‘Fair Access to Insurance Requirements’ may provide guidance for other places where insurers withdraw from high risk areas and the experience of short-term response and long-term recovery following Hurricane Katrina provides a compelling study of failures and successes.

<sup>r</sup>In this respect, adaptation policy sits at the opposite end of the spectrum from mitigation policy in terms of where action must occur in order to be effective. The place where emissions reductions occur is irrelevant to the effectiveness of such reductions in avoiding dangerous climate change, whereas adaptation strategies can only be effective in promoting adaptation if they are directed toward the specific adaptation needs of particular groups or places.

<sup>s</sup>The principle of subsidiarity applies in European Union law as a check on the distribution of legislative competencies between the European Union and Member States (*Treaty establishing the European Community*, Art 5). The principle stipulates that in areas of shared competence, the Union will not take action unless it will be more effective than action at that national or sub-national level.

<sup>t</sup>For example, a fair and sustainable option for the owners of exposed property may be prohibitively costly for local governments who must balance competing demands on scarce resources. Also see p 340 of Ref 53, citing Refs 54 and 55.

<sup>u</sup>Harremoes et al.,<sup>14</sup> argue for more agile decision-making systems that guard against the ‘ubiquitous experience of surprise,’ by acknowledging the limits of current knowledge and what lies outside risk assessment and using a wider range of knowledge and disciplines, pp 186–192.

<sup>v</sup>For international formulations, see for example, *World Charter for Nature*, Art 11(b), *Ministerial Declaration of Sustainable Development in the ECE Region*, Bergen, May 1990; *Rio Declaration on Environment and Development*, Principle 15; *Convention on Biological Diversity*, Preamble; *United Nations Framework Convention on Climate Change*, Art 3.3, referring to ways to achieve a precautionary approach. For national examples, see *Great Barriers Reef Marine Park Act 1975* (Cth) s39Z(1); *Environment Protection and Biodiversity Conservation Act 1999* (Cth) s3. There are numerous state Acts that incorporate the precautionary principle.

<sup>w</sup>Rio Declaration on Environment and Development, Principle 15.

<sup>x</sup>Moser et al., Adaptation to climate change in the Northeast United States (Ref 40, p 653).

<sup>y</sup>Referred to as the climate change commitment, this delay is 'due to the thermal inertia of the ocean and slow processes in the biosphere, the cryosphere and land surfaces'. IPCC 2007b above note (d), at p.871.

<sup>z</sup>For an example from Australian tort law, see *Cubillo and Gunner v Commonwealth of Australia*, Federal Court of Australia (Sackville, Weinberg and Hely JJ), (2000) 174 ALR 97.

<sup>aa</sup>Harremoes et al.,<sup>61</sup> (asbestos, fisheries, radiation, benzene, sulphur dioxide, bovine spongiform encephalopathy (mad cow disease), the use of growth promoting hormones and antimicrobials in livestock production); drought policy in Australia.<sup>60</sup>

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