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Strategic Options for Adapting Biodiversity Management to Climate Change

July 2011

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Overview

Climate change threatens biodiversity and its role in supporting human development around the world. It is vital that policymakers act to strengthen the resilience of ecosystems to climate change in order to respond to this threat. This paper and the accompanying Legal and Policy Tools to Adapt Biodiversity Management to Climate Change: A Resource Manual provide a menu of solutions for doing so. Using the principles of adaptive, ecosystem-based management, policymakers can implement innovative legal and policy frameworks to ensure sustainable use and conservation of biodiversity in the face of climate change. This paper sets forth (1) the need to adapt biodiversity management to climate change; (2) the process of adaptive management that may be applied to natural resources; and (3) options for using legal and policy tools to manage biodiversity in a changing climate.

Key Messages

1. Greater commitments of financial and human resources are critical to defending biodiversity in the face of climate change. This is an investment with long-term payoffs, because only management that considers climate change impacts (the adaptive approach) will allocate resources where they will be most effective and ensure that ecosystems continue to provide goods and services that support healthy economies. Management that fails to consider climate change (the status quo) will lead to biodiversity die-off and economic losses. Thus, failing to act is itself an action that will produce negative consequences.

2. Adaptive, ecosystem-based management provides a model to respond to climate threats despite scientific uncertainty. It manages biodiversity in a changing environment through decision making based on planning, monitoring, information sharing, coordination, and community involvement. Adaptive management can be employed in the areas of resource-use permitting, protected areas, private conservation, and communal resources, among others.

3. Clear rules and procedures for adaptive management allow flexibility without sacrificing accountability. Within a legal framework that includes oversight and strong public participation, adaptive management is more rigorous than conventional management approaches because it requires officials and stakeholders to periodically update their understanding of the ecosystem and take action on emerging threats.

4. In many cases, existing laws and policies can be used to undertake adaptive biodiversity management. Clarifying the scope of existing authorities through regulatory changes and guidance materials and adapting existing institutions to new tasks is an urgent adaptation priority for all governments. Rewriting laws and creating new policies may be necessary, however, in some contexts.

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The Need for Adaptive Biodiversity Management

Climate change is dramatically changing ecosystems and jeopardizing the services they provide humans. Scientists estimate that climate change could contribute to one-third of extinctions by 2050, including many species long thought "immune" to extinction risk.[1] This has significant consequences for ecosystem health, human livelihoods, and economic development:

- Fishing communities around the world are vulnerable to fisheries collapse due to climate change, ocean acidification and warming, and other stressors.[2]
- Pastoralists must travel greater distances to find suitable water for livestock due to increasing drought conditions in some areas and receding glaciers in others.[3]
- The world is on track to lose 80 percent of coral reefs by mid-century, placing at risk coastal communities and tourism-dependant livelihoods.[4]
- A 2 ºC rise could result in the conversion of 20-40% of tropical rainforests to savannah, causing a collapse in forests' genetic biodiversity and loss of associated incomes from timber and non-timber forest resources.[5]

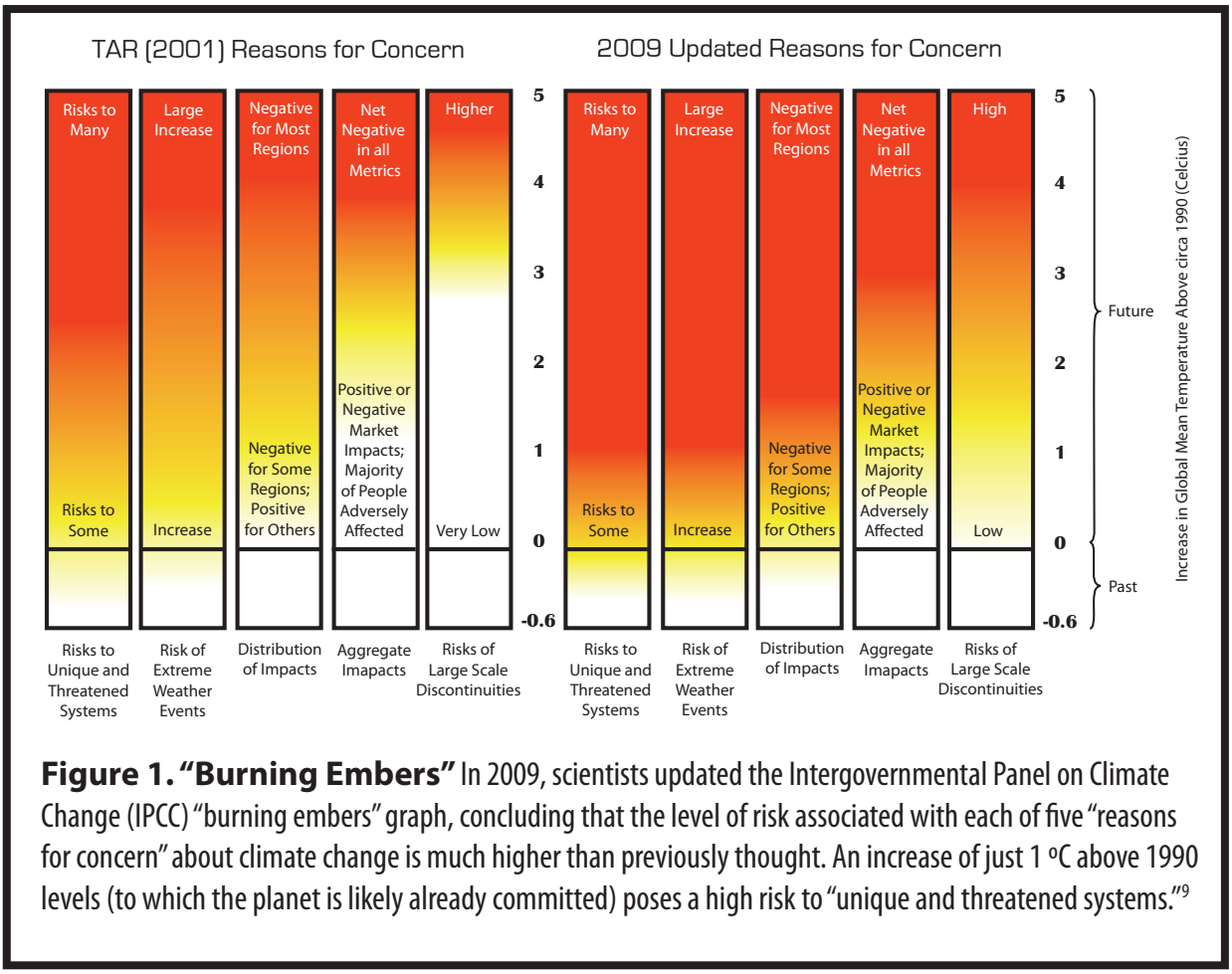

Figure 1. "Burning Embers" In 2009, scientists updated the Intergovernmental Panel on Climate Change (IPCC) "burning embers" graph, concluding that the level of risk associated with each of five "reasons for concern" about climate change is much higher than previously thought. An increase of just 1 ºC above 1990 levels (to which the planet is likely already committed) poses a high risk to "unique and threatened systems."[9]

A Failure to Respond A 2009 survey of nearly two hundred resource managers by the U.S. government found that their climate adaptation efforts were weak to non-existent for the following reasons:

- **Low Priority**: Limited resources are dedicated to more immediate needs, while long-term threats like climate change go unaddressed.
- **No Data**: Insufficient site-specific data make it hard to predict the localized impacts of climate change, and more difficult for officials to justify current expenses for adaptation efforts for potentially less certain future benefits.
- **Weak Frameworks**: Adaptation efforts are constrained by a lack of clear roles and responsibilities among government officials.[11]

Degraded ecosystem services such as lost storm-buffering and erosion control leave humans even more vulnerable to climate change-related losses and disasters:

- The loss of just one kilometer of coral reef can expose five times as much shoreline to extreme storms and coastal flooding.[6]
- Mangroves can soak up 70 to 90 percent of the energy from storm surges, but face a serious risk of damage or loss stemming from climate change, in combination with other stressors.[7]
- Deforestation and soil erosion on hillsides leave communities at greater risk of mudslides and flooding.[8]

These examples and many more point to the need for dramatic action to conserve biodiversity in the face of climate change. Unfortunately, looking at most countries' legal and policy frameworks for biodiversity, it would not even be clear that climate change is happening, much less that urgent steps must be taken immediately to address it.

Current Biodiversity Management Practices Do Not Readily Adapt to Climate Change

Despite the devastating impacts of climate change, biodiversity managers, users (from small communities to large multinational companies), and conservation organizations struggle to respond. The reasons for this are numerous. They lack funding, clear mandates for action, and a framework for moving forward. Perhaps the greatest challenge is the inherent uncertainty of climate change over the long term. Models, although improving, are often unable to predict the frequency, severity, and location of regional climatic shifts, much less secondary effects such as fire and invasive species spread. Beyond the lack of adequate and reliable historical data, the changing underlying conditions may render it impossible to establish baselines against which to evaluate the status of ecosystems. If managers lack a baseline (or face a shifting baseline) for rates of new growth in tropical forests, for example, it is very difficult to prove that decreasing rates are due to climate change and not some other cause, hindering an effective management response.[10]

Laws and policies that fail to consider change and complexity in ecological relationships also present barriers to action. Such laws may, for example, require officials to dedicate limited resources to restoration of species that are untenable under changing climate conditions. In a 1996 case, for example, the Kenyan High Court enjoined the Kenya Wildlife Service from moving the rare hirola antelope to a protected area outside its native habitat.[13] The court reasoned that the

authorizing statute for wildlife protection only "entitle[s] [the Service] to conserve the wild animals in their natural state. It does not entitle it to translocate them" to new habitat.[14]

Climate change voids this reasoning. Legal systems can no longer function on the assumption that there is any "natural state" in an area where climate change is fundamentally altering the ecosystem. In this case, policymakers may find that a minor adjustment in the law to respond to climate impacts provides a powerful boost to the agency's authority to take adaptive measures to protect wildlife.

Undertaking Broad Assessments of the Legal Framework

The first step toward building fully adaptive management laws and policies is to assess the strengths and weaknesses of existing laws to identify priority areas for reform. Climate change affects all sectors of natural resource use and all categories of environmental protection. A full legal assessment of adaptive capacity to respond to climate change within the regulatory frameworks that target biodiversity should include laws covering a wide range of topics. The assessment could begin with an inventory listing and categorizing relevant laws, including:

- Framework environmental law
- Environmental impact assessment (EIA)
- Water (quality and quantity)
- Land use planning and zoning
- Agriculture and grazing
- Forestry
- Coastal zone
- Fisheries and aquaculture
- Mining and drilling (non-renewable resource extraction)
- Protected areas
- Wildlife and wildlife trade
- Disaster management and emergency preparedness planning
- Other: Insurance, public health, contracts, real property

Once an inventory of relevant laws and regulations has been taken, the next step is to perform a **gap analysis**. This is used to determine where legal frameworks may need to be adjusted or amended to respond to climate change. Existing legal provisions will generally fall into one of three categories:

- **High Potential Capability**: The law establishes or illustrates a model with strong potential for improved management outcomes in response to climate change
- **Moderate Potential Capability**: Provides some opportunity for improving upon existing frameworks to make

> Parties to the Convention on Biological Diversity recognize the importance of reviewing national-level resource laws and policies, encouraging national governments to "integrate biodiversity considerations into all relevant national policies, programmes and plans in response to climate change; taking into account the maintenance and restoration of the resilience of ecosystems which are essential for sustaining the delivery of their goods and services."[12]

them more responsive to climate change

- **Low Potential Capability**: Contains serious gaps in adaptive capacity that make resources and people more vulnerable to climate change

The gap analysis will allow researchers to generate a list of key recommendations for changes in laws, policies, regulations, or practices that can be presented to a target audience (e.g., lawmakers, regulatory officials, stakeholders, or the public).. There are several considerations to keep in mind:

- **No-regrets approaches**: Often the most politically popular policies for climate adaption will be those that provide significant 'co-benefits' outside the climate policy arena. (These are also referred to as 'no-regrets' strategies.) Those designing policy recommendations for adaptation, however, should not let the political expediency of 'no-regrets' options rule out reforms that focus exclusively on climate change.
- **Valuing the future**: Cost-benefit analysis is a quantitative technique that allows policymakers to assess which activities generate the most benefit at the least cost. While it is a powerful tool, it may produce skewed results in the case of climate change adaptation, which seeks to improve conditions over long time horizons (in some cases 100 years or more). Policymakers should note that there is disagreement among economists about how benefits and costs that occur in the distant future should be valued.
- **High-vulnerability subgroups**: Adaptation measures that achieve significant benefits averaged over the entire population may fail to solve problems, or may even create new hardships, faced by vulnerable subgroups. These include ethnic minorities, indigenous groups, women, children, the elderly, the disabled, and others. Measures to address special needs within these groups are often an important component of adaptation measures.
- **Recognizing and negotiating trade-offs**: Changing the laws to respond to climate change may force trade-offs between competing resource sectors and users. Identifying the need for change, negotiating compromises, and reaching consensus on new courses of action will all help diffuse conflicts over emerging resource scarcity issues driven by climate change.

Agreeing on the Need for Change in Australia's Murray-Darling Basin

Municipalities in the Murray-Darling Basin in southern Australia, though still suffering a severe water crisis, have made improvements in rationalizing water management by combining reasonable limits on uses, pricing mechanisms, attention to fairness in allocation, and other measures.[15] This process stemmed from a broad recognition that climate change rendered current levels of water use unsustainable, and that solutions that worked in the past (building more dams) were no longer effective.[16] The trade-offs that climate change will force governments around the world to make require open stakeholder negotiation combined with rigorous quantitative analysis.

Strategic Environmental Assessments Many national governments now have strategic environmental assessment (SEA) mandates that enable them to assess the capacity of laws and policies to confront climate change. SEA includes a range of "analytical and participatory approaches that aim to integrate environmental considerations into policies, plans and programmes and evaluate the interlinkages with economic and social considerations."[17] SEA closes gaps in legal frameworks by providing environmental analysis of laws and policies and by establishing procedures for impact assessment of higher-level government actions. For example, an SEA for a program targeting a coastal region may reveal that agricultural runoff is contributing to the degradation of a coral reef that brings in substantial tourism revenue. Because resilience of the reef to climate impacts will be improved by reducing nutrient pollution, the SEA could demonstrate that the economic cost of more stringent agricultural policies is outweighed by the benefits of enhanced coral reef resilience and associated fishing and tourism revenues.

A completed gap analysis can be used to set a course for legislative action with widespread support from key constituencies.

Harnessing Law and Policy to Create Climate-Resilient Biodiversity Management

Governments can address the challenges posed by climate change by establishing decision-making processes that are flexible (they respond to new circumstances) and accountable (they employ enforceable standards to achieve long-term objectives). The Environmental Law Institute's *Resource Manual for Adapting Laws to Protect Biodiversity from Climate Change* provides a variety of legal and policy measures to create this flexibility and accountability. The central theme of the Resource Manual is adaptive management, which builds resilience to climate change into biodiversity management.

Adaptive management can be viewed as a means to carry out the **Precautionary Principle** in responding to climate change. Both the Precautionary Principle and adaptive management create a mandate and an approach for responding to emerging risks in the face of incomplete scientific understanding. Whereas the Precautionary Principle governs initial decisions at the front end of management (making the initial decision about whether to act), adaptive management provides the way forward once a decision has been made (informing how to act). Adaptive management allows affected parties to learn through implementation of a decision, so that they are better informed as future directions are charted. It makes new information

The Precautionary Principle
"In order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."[18]

and lessons learned an integral part of the management process.

What Is Adaptive Management?

Adaptive management calls for policymakers and resource managers to take an ecosystem-level view of the resource they manage. It then sets forth a management process using continuing phases of assessment, design, implementation, monitoring, and adjustment to oversee natural systems. Adaptive management is often expressed as "**learning-by-doing**," consisting of a repeating cycle of core management activities:[19]

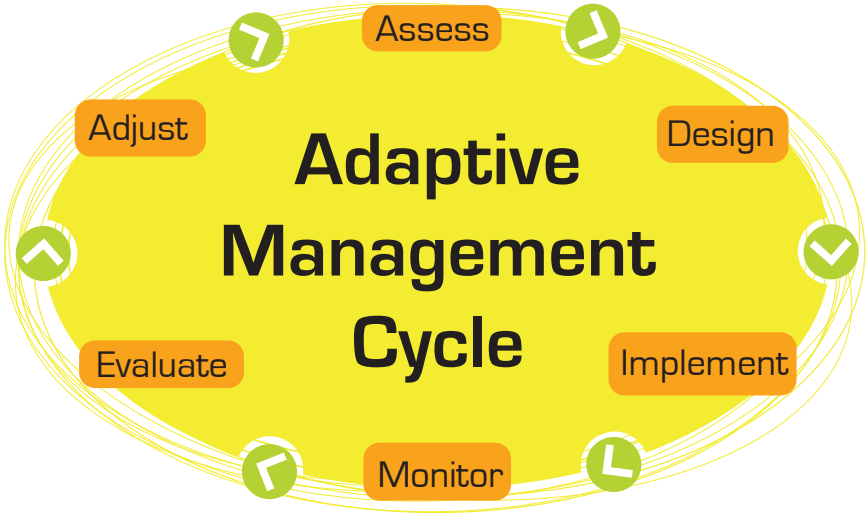

Figure 2 The Adaptive Management Cycle

For example, a manager of a protected area seeking to apply an adaptive management approach would first consider the goal of the protected area: what is to be conserved and why. Next, she would assess the state of knowledge about the area's resources and use this information to design a preferred management strategy. The manager would implement this strategy and then monitor the outcome over time. On a predetermined periodic basis (for example, every six months), the manager would evaluate data on the status of the managed resource and, in consultation with regulators, stakeholders, and the community, adjust the management strategy to reflect both lessons learned in managing the resource and new developments and information. Inherent in this design is a need for continuous data gathering and a commitment to following the process.

The exact shape of an adaptive management approach for biodiversity will depend on the circumstances in each country, the resource being managed, the financial and human resources available, and other factors. But several common features are required to make adaptive management work:

- Well-defined **goals** for biodiversity management that are consensus-based and made available to all stakeholders.
- A set of measurable **benchmarks** using ecological reference points that trigger new actions as conditions change.
- A **decision-making process** that provides a framework for reassessing and adjusting policies, plans, and standards as conditions change and new information is gathered.
- **Monitoring** requirements and procedures for data collection and

analysis that are responsive to changes in ecological conditions and overall ecosystem health.

- **Information transparency** and sharing with the public, stakeholders, and other agencies and governments to inform adaptive decision making.
- **Coordination** across sectors and institutions to develop and implement coherent policies at the ecosystem level.
- **Enforceable standards** to ensure core objectives are met.
- **Public participation** measures that include all stakeholders and give them incentives to participate and a meaningful role in decision-making processes.

The mandate to gather, use, and share high-quality information is critical to all aspects of adaptive management. This information can be quantitative (e.g., data from experiments designed to learn about climate change impacts) or qualitative (e.g., community knowledge collected over many generations of experience).

Does Adaptive Management Give Too Much Authority to Managers?

Adaptive management requires increased flexibility in decision-making processes, which usually gives more authority to resource managers. This has raised the concern that adaptive management undermines or weakens oversight of decisions affecting natural resources, exposing the process to abuse. In a collaborative adaptive program, however, courts, communities, businesses, NGOs, and other agencies all play a role in ensuring that resource management decisions meet conservation goals. Including strong oversight in an adaptive management approach will help ensure that the flexibility required for such management is not abused and does not lead to poor decision-making. Two U.S. cases illustrate this point. In one, a court upheld an adaptive management plan for an endangered fish because it contained specific criteria that would trigger new legal protections and included mandatory regulation of water flows as a backstop measure. The same court struck down a similar plan for another endangered fish because it did not define operational criteria for water managers, while its contingency measures were vague and open-ended. These cases help mark the line between accountable adaptive

Reliance on traditional community knowledge. Traditional approaches to biodiversity management may complement, support, or even replace the need for more highly techniques. For example, the remote village of Quezungal in Honduras was one of a few communities that did not lose its entire crop to Hurricane Mitch in 1998. It turned out that the Quezungal people's use of traditional agroforestry methods provided protection against the hurricane's effects, while other farming methods taught in agriculture colleges and practiced in neighboring regions were ill-suited for the terrain and thus vulnerable to failure in the face of a severe weather event. Because of its success, the Quezungal method was promoted actively around the country by the Honduran government in collaboration with the Food and Agriculture Organization (FAO).[20]

Flexibility through Regional Variation of Programs, Standards, and Requirements A "one-size-fits-all" approach may not be appropriate for resource managers in different regions seeking to confront climate change impacts. Vietnam's "Second National Strategy and Action Plan for Disaster Mitigation and Management – 2001-2020" (the Plan) provides an example of how flexibility can be incorporated into natural resource management by tailoring regulatory programs to local conditions.[21] Each region of the country is charged with carrying out activities to mitigate natural disasters, but can develop strategies that are sensitive to its particular geographical and ecological context. For example, in some coastal regions, the Plan calls for strengthening dyke systems, reforesting mangroves, and protecting forests. The Eastern Coast and Islands apply the approach "Proactiveness in disaster prevention, and adaptation for development," while the Mekong River Delta applies the approach "Living with flooding."[22] The recognition that ecological and geographical contexts have different needs and requirements allows for flexibility through place-sensitive policies.

management and management that is too flexible to stand up to legal scrutiny.[23]

Options for Implementing Adaptive Biodiversity Management

Policymakers can ensure biodiversity management is flexible and accountable by making strategic revisions to existing laws and policies and by proposing more targeted new laws and institutions to implement adaptive management.

Strategic Use of Existing Legal Framework

Existing laws often provide authority to undertake at least some elements of adaptive management. A clear set of regulatory tools and procedures to drive adaptive governance, however, may be lacking. Those who wish to see that vision integrated throughout their laws should strategically build on existing programs and regulatory frameworks, and take advantage of opportunities to insert the principles of adaptive management into their legal framework, such as when laws are amended or reauthorized.

Specific laws should be evaluated individually for their adaptive capacities and core weaknesses. Adaptive measures can be incorporated as amendments to existing legal authorities, or they may take the form of decrees, executive orders, policies, or other regulatory instruments that call on one or more resource agencies to use their existing authorities to proactively undertake adaptive management. Table 1 and the sidebar on pages 13-14 describe opportunities to assess the role of laws in reducing vulnerability to climate change.

Systematic Reform through New Legal Authorities

In addition to strategically using individual laws and policies to increase management capacity to adapt to climate change, policymakers could also enact a broad-reaching National Adaptation Law or a National Adaptive Management Act.[27] Such a law would apply to all ministries, cutting across resources, institutions, and sectors, as a

means to 'mainstream,' or incorporate, adaptation approaches throughout government actions. The law could give managers and resource users a clear mandate and authority for incorporating resilience to climate change into a wide range of regulatory activities.[28] It could include such tools as resources for monitoring, authorizations to set up experimental zones, periodic assessments, and a mandate to revise legal frameworks based on lessons learned.

Table 1. Building Climate Resilience into Biodiversity Laws and Policies

Resource	Climate Change Impacts	Management Needs	Enabling Laws & Policies
Marine Fisheries	• Fish species shift in population size and distribution, generally to higher, cooler latitudes • Warming oceans killing coral reefs and associated species • Acidification threatens shellfish and other species	• Real-time monitoring of fish stocks to adjust catch quotas • Protection of spawning areas and other critical habitat from overfishing and other uses • Informing fishermen of safe fishing locations • Control of land use practices to reduce pollution runoff and other land-based stressors	• On-board observer program for catch-limit enforcement and scientific data gathering • Institutional mechanisms for information exchange • Strategic environmental assessment for multi-sector approach to ecosystem services • Marine Spatial Planning that sets aside critical habitat areas
Forestry	• Rising temperatures and drying conditions cause shifts in vegetation types • Loss of canopy species • Emergence of new plant communities • Carbon markets (e.g. REDD) create new mix of incentives for conservation	• Timber permits adjustable based on monitoring for change in indicators such as nutrient and water cycles • Remediation of logged areas targeted to future conditions • Ability to manage areas for ecosystem services other than carbon storage	• Permits contain reopener clauses to adjust terms and conditions, and must require consideration of new information • Remediation requirements intensify if logging more damaging than expected • REDD frameworks that include social and ecological values
Protected Areas	• Plants and animals migrate out of protected areas and onto non-public lands • Historical ecological relationships unravel; new communities form • Increased pressure to access scarce resources in protected areas by humans	• Authority to protect habitat on marginal lands and lands lacking full protected status • Ability to prioritize protection and restoration activities • Local stakeholder engagement and education to build conservation buy-in	• Set long-term targets based on future conditions • Statutory instruments for land swaps to protect priority habitat • Coordination of private and public land conservation efforts • Communities hold secure land tenure to ensure sustainable use • Revenue-sharing with locals
Freshwater Supply	• Extreme fluctuations in water cycles • Lack of water for basic human needs and aquatic and riparian habitats • Flooding and inundation in other areas	• Rationalized prioritization of water uses • Adjustment of water quotas to reflect changing conditions • Protection of aquatic and riparian habitats	• Water-sharing agreements adjust to future flow expectations • Regulation of water usage • Minimum in-stream flow standards to protect habitat
Coastal Zones	• Sea level rise inundates coastal habitat • Increasing storm risks • Erosion undermines coastal structures • Salinization of freshwater aquifers	• Coastal planning incorporates long-term changes in shoreline • Revision of acceptable land uses in high-risk areas • Restoration efforts targeted to future conditions	• Planners required to consider climate change in land use zoning • Insurance programs reflect heightened risk of coastal zones • Rolling easements alter land uses, protect property values

Summary of Legal and Policy Tools

This section provides a list of possible legal and policy options taken from Resource Manual that accompanies this volume. These options should not be implemented all together. In fact, some options will be incompatible or redundant. Users should consider whether each option is useful, feasible, and appropriate for their country or region.

The options for policymakers are organized according to the following six categories:

- Organizing adaptation institutions
- Developing accountable adaptive management programs
- Using legal rights and safeguards to promote adaptation
- Designing climate-resilient protected areas
- Decentralizing adaptation to local authorities and communities
- Facilitating private-sector adaptation efforts

Following each option, the most relevant section(s) of the Resource Manual are listed in parentheses.

Organizing Institutions

Existing institutions and authorities can be given new mandates to develop adaptation programs and regulations and new authorities can be created to provide dedicated regulatory expertise on climate change impacts on biodiversity.

Options:

- Establish an independent body of experts and stakeholders to make legislative recommendations on policies for adaptation and biodiversity (7.1)
- Designate inter-agency contact persons (liaisons) to coordinate on cross-cutting climate change adaptation issues as they arise in different regulatory contexts (7.1)
- Assign responsibility to each line ministry to consider climate change in its activities and programs (for example, through use of vulnerability assessments, environmental impact assessments (EIA) and strategic environmental assessments (SEA)) (7.1, 7.2)

Ensuring enforcement of standards. Ordinary people concerned about their environment should have the right to be heard in court or administrative proceedings to help oversee resource management. The legal doctrine of locus standi, or standing, generally provides that only people with "real" injuries that can be redressed through the law should have their cases heard. With climate change, many people will be concerned about impacts (or management decisions) that may be difficult to quantify, located in the future, or suffered by a large number of people. For countries with broad standing provisions that allow ample access to courts, the diffuse nature of "climate injury" will not frustrate effective public participation in biodiversity management. In other countries, the more limited role of courts in environmental enforcement, or the presence of other obstacles such as high court fees, may need to be reassessed to determine if these or other obstacles hinder full citizen participation in natural resource decision-making.

- Establish regional coordinating bodies that exist independently of existing regulatory bodies to fill adaptation policy needs not covered by current regulatory programs (7.1)
- Establish a climate change information service that operates early warning systems and other climate monitoring systems, provides reports on climate indicators for resource users, and maintains publicly accessible databases (7.1)

National Adaptation Programs of Action (NAPAs)

The UNFCCC established the NAPA process as a method for countries to assess their vulnerability to climate change and adaptation needs.[24] Guidelines for carrying out NAPAs include policy reform as a "priority activity" and "key adaptation need."[25] The NAPA process provides a model for assessing legal frameworks. In 2008, the Government of Madagascar jointly convened a workshop, "Assessing the Impacts of Climate Change on Madagascar's Biodiversity and Livelihoods," in Antananarivo, Madagascar. The workshop participants recommended four main priorities to facilitate the government's response to climate change.

- First, the establishment of an inter-ministerial task force on climate change to facilitate environmentally sound adaptation measures across sectors such as mining, oil and gas, tourism, agriculture, and fisheries. Such measures would be taken under the Madagascar Action Plan (MAP) (a strategy document developed by the Government of Madagascar to guide development planning in the country) and regional action plans.
- Second, integration of data and recommendations emerging from the workshop into Madagascar's NAPA.
- Third, the establishment of a rural development policy around areas most vulnerable to climate change, such as by updating the Rural Development Policy Letter to integrate workshop recommendations.
- Fourth and finally, the development and dissemination of strategies for information, education, and sensitization around the issue of climate change across all levels and sectors of society.[26]

A strong coalition of communities, officials, and civil society organizations is now moving forward on these recommendations.

- Create a ministerial-level adaptation authority to carry out regulatory responsibilities, serve as adaptation coordinator, and establish adaptation as a top government priority (7.1)
- Establish an expert scientific committee to develop recommendations for biodiversity adaptation priorities for non-government, private, and industrial sectors (7.1)
- Advocate strengthening of existing international authorities to coordinate and support adaptation or the creation of a new international adaptation secretariat set up under a multilateral or regional treaty organization to facilitate transboundary adaptation (7.1, 12.4)
- Enter into memoranda of understanding or agreement between government units delineating adaptation responsibilities (for example, giving a national

agency standard-setting and oversight roles and a subnational agency permitting and enforcement roles) (7.1)

- Include climate change and biodiversity considerations and programs in all relevant national-level planning processes, including economic development plans, natural resource and environmental planning, and sector- or industry-specific planning processes (7.1)
- Establish a program for agencies to enter into partnerships with academic institutions, scientific bodies, environmental NGOs and other stakeholder groups to stretch limited public resources for monitoring and studying climate change impacts (5.3)

Developing Accountable Adaptive Management Programs

Adaptive ecosystem management provides a set of tools to confront uncertainties and conditions caused by climate change and to promote biodiversity. Policymakers can give managers and stakeholders flexibility without sacrificing environmental protection, social values, or procedural safeguards.

Options:

- Explicitly authorize and establish protocols for carrying out adaptive management for resource-management units, including extraction, mixed-use, recreational, or conservation areas (2.1)
- Authorize the use of test plots or zones as pilot projects for learning about best techniques and implement a process by which successful approaches can be taken to scale or shared (2.1)
- Require managers to account for social equity concerns in experimental management programs in which the risks and benefits of innovative approaches are unknown (2.2)
- Provide managers with regulatory tools, funding, resources, and volunteer and incentive programs to undertake studies to learn how ecosystems evolve in response to climate change (5.1)
- Require the use of deep historical data and long-term future projections to allow managers to develop the fullest possible understanding of the ecosystem, how it is changing, and which management, use, and restoration targets are optimal (5.1)
- Provide managers with the authority to select a limited set of indicators for monitoring that reveal the greatest amount of information about the ecosystem and how it is changing (e.g., identify an indicator species for which a change in population or some other feature will indicate a larger change in the ecosystem's chemical or physical features) (5.2)
- Require managers to establish a system of reference points or thresholds based on climatic and other ecological indicators that, when crossed, will trigger adjustment to a new plan or strategy (6.2, 8.1)
- Allocate resources on a rolling rather than fixed basis to adjust to changing availability (for example, modify water basin agreements so that water-use rights are based on percentages of in-stream flow rather than an absolute number) (10.3, 11.5)
- Legally characterize authorizations to use resources as limited privileges, not property rights, that are conditioned

on compliance with specified terms and the continued viability of natural resources under changing climate conditions (10.1)

- Establish processes by which licensing authorities may adjust the terms and degree of mitigation measures to account for unanticipated impacts on biodiversity resources (10.2)
- Create robust monitoring and information-reporting requirements for regulated entities to report changes in the ecosystem resulting from direct-use activities as well as changes in the ecosystem observed to be occurring regardless of cause (10.5)
- Require resource managers to use periodic decision checkpoints at which they must use collected data to reevaluate management strategies (10.5)
- Incorporate flexible compliance targets in authorizations to reflect additional needs created by climate change (for example, ratchet down pollutant levels or harvest quotas for climate-stressed ecosystems and species) (10.3)
- Provide resource managers with clear administrative authority to adjust terms of permits or user rights based on changing ecological conditions, including reopener clauses to change the terms of permits as necessary and the authority to impose greater mitigation measures if the predicted impacts of a project or activity are made worse by climate change (10.2)
- Establish a procedurally clear and open system of administrative and judicial review to redress grievances and challenge or defend government actions based on claims that government action failed to incorporate consideration of climate change impacts on biodiversity, or that government action to protect biodiversity infringed on private rights (9.2, 9.3, 9.4)

Using Legal Rights and Safeguards to Promote Adaptation

Traditional legal theories and rules may be enlisted to promote adaptive management of biodiversity. Enforceable constitutional rights, common-law causes-of-action, citizen suits, rules governing private property and land tenure, and other laws provide tools to compel and guide adaptation efforts.

Options:

- Interpret the right to a clean and healthy environment to include an obligation on public and/or private actors to avoid maladaptive actions (9.1)
- Interpret the right to a clean and healthy environment to include an obligation on public and/or private actors to take adaptive measures in response to climate change (9.1)
- Ensure strong property rights in land or resources (either for individuals' private property or for community resources) to encourage owners to protect these resources (9.2)
- Interpret private property rights so that reasonable adaptation measures required on private lands do not constitute a taking of private property, or else compensate owners for unavoidable takings (9.2)
- Interpret private or communal rights in land or other property to provide a basis for challenging activities on other lands that, in conjunction with

the impacts of climate change, damage biodiversity (9.1, 9.2)

- Include within the public trust doctrine an interest and obligation on the government to maintain shore habitat, water bodies, submerged lands, fisheries, wildlife, animal migrations, or other natural features on behalf of the public and future generations (9.1, 13.4)
- Use innovative interpretations of public trust doctrines to develop new legal theories for conservation obligations on private lands, such as rolling easements to protect shoreline access and coastal habitat from sea level rise (13.4)
- Adapt rules on access to courts, such as the doctrines of locus standi, to ensure effective citizen oversight of adaptation measures and policies, even where the risk of climate-related injury is uncertain (9.4)
- Use judicial procedures such as open witness testimony, limited confidentiality rules for important environmental information, and broad rules for determining the relevance of scientific information to improve the role of courts in climate change adaptation (9.5)

Designing Climate-Resilient Protected Areas

Habitat conservation and connectivity over public lands and waters are important tools for managing current and future climate change impacts. Given the need for much larger areas of habitat to facilitate shifts in species' ranges, innovative programs for public-private collaboration and local community engagement are essential.

Options:

- Engage scientific experts to use bioclimatic modeling and other scientific tools to identify new areas for conservation based on likely future climatic conditions, human use of natural resources, and future needs, and biodiversity trends such as likely species movements (12.1)
- Establish a national program to enhance the connectivity of protected area networks through the expanded use of corridors, stepping stones, and buffer areas on marginal and non-public lands or waters, taking into account human needs and by providing economic incentives for community participation (12.2)
- Use rolling easements, the concept of a public trust in wildlife and other innovative tools to enhance the government's authority to manage biodiversity on non-public lands, taking into account the rights of private and communal land holders, and including incentives, funding, and support for private commitments (13.4)
- Partner with local and indigenous communities in the establishment of new protected areas through multiple-use programs, revenue-sharing agreements, economic development opportunities, and other incentives for participation (12.3)
- Establish transboundary conservation areas through agreements, treaties, or other legal authorities that establish a program for joint implementation, sharing of responsibilities, mechanisms for compliance, mutual support, and equitable allocations of responsibility (12.4)

- Establish new policies and regulations for the translocation of organisms to more suitable habitat under future climatic conditions in appropriate circumstances, taking into account larger ecosystem needs and possible unintended consequences of species movements (12.5)
- Establish and support programs for invasive species monitoring, prevention, and control, taking into account the need to prioritize invasive species threats and recognizing that many species' range-shifts in response to climate change are non-threatening (5.2, 12.5)

Decentralizing Adaptation to Local Authorities and Communities

Because climate change will be felt primarily at the local level, it is important to have local communities engaged in adaptation efforts. In some cases, traditional communities may have already developed locally-sensitive and adaptive management techniques. Community-based natural resources management may be an excellent adaptation strategy in appropriate circumstances, or it may inform the development of adaptation strategies at a larger scale.

Options:

- Establish a process by which local communities that meet certain requirements may develop and implement their own adaptation plans (3.3, 3.4, 11.1)
- Establish and support outreach and education efforts to inform the public about adaptation needs (3.1, 3.2, 3.4, 11.2)
- Legislate guaranteed and enforceable participation and consultative roles for the public and community members in adaptation policymaking related to biodiversity (3.1, 9.3)
- Fund and otherwise support community and stakeholder participation in the design and implementation of adaptation strategies at all scales (local, provincial, national, etc.) (3.1, 11.2)
- Fund and otherwise support extension services to provide training and capacity building for local adaptation planning (11.1)
- Engage with existing networks for information exchange or establish new networks to allow regions and communities to participate in peer-to-peer learning on best adaptation techniques (3.1, 3.2, 3.3)
- Use information- and benefit-sharing programs to encourage local communities to develop adaptation measures, taking into account and respecting legal rights concerning traditional knowledge (3.1, 3.2, 3.3, 3.4, 11.3)
- Encourage managers to enter into collaborative adaptive management programs with local communities in circumstances where full devolution of power is not possible or appropriate (3.4, 11.4)
- Devolve full resource management and adaptation responsibilities (for example, setting and adjusting times for access, harvest quotas, etc.) to local or indigenous communities that have demonstrated adaptive capacities, sustainable resource use systems, and fair and equitable rules of access to common resources (11.4)
- Provide for periodic review and assessment of devolved adaptation efforts and retain backstop regulatory

authority in order to maintain environmental safeguards and prevent capture of the process by local elites, marginalization of vulnerable subgroups, or other unintended consequences of decentralized resource control (3.4, 11.4, 13.4)

Facilitating Private-Sector Adaptation Efforts

Private actors have important roles to play in biodiversity adaptation programs. Policymakers can authorize private conservation areas, tax rules, grant programs, official development assistance, and other publicly-operated funding programs to ensure these programs support effective adaptation practices to protect biodiversity. Policymakers should also search for and phase out support for activities that encourage maladaptive behavior.

Options:

- Establish awards and/or labeling systems to encourage adaptive business practices with respect to biodiversity, and verify compliance through third-party audits (13.2)
- Encourage and incentivize private adaptation measures, so long as they are consistent with public adaptation planning (13.2)
- Discourage, regulate, or forbid private adaptation activities that are maladaptive or otherwise inconsistent with publicly-established adaptation strategies (13.2)
- Legislatively authorize or adjust private conservation area requirements to allow for their continuation and management in the face of climate change impacts (12.2, 13.1)
- Establish a system to coordinate public and private land and water conservation efforts to create a climate-resilient, interconnected network of protected areas (12.2, 13.2)
- Authorize the use of land swaps and/or debt-for-land swaps with private land owners to establish a more coherent, climate-resilient system of protected areas, taking into account the need for safeguards to protect the public interest on private property and community property (13.2)
- Mandate protections for native ecosystems and biodiversity adaptation in payment-for-ecosystem-service programs, including carbon market mechanisms such as REDD and CDM projects (13.2, 13.3)
- Eliminate subsidies that cause maladaptive and ecologically harmful choices (13.2)
- Use tax breaks and other financial mechanisms to encourage private adaptation efforts that are consistent with public adaptation planning (13.2)
- Provide public funding for private or academic research into locally-appropriate adaptation technologies, such as less water-intensive irrigation systems (6.1)
- Dedicate royalties or assess severance taxes or other fees on resource access or extraction to fund climate adaptation programs to protect the resource or the surrounding ecosystem (13.2)

Conclusion

Climate change is fundamentally altering ecosystems and the natural resources upon which all human societies depend. It is vital to implement management practices that reflect the continuing impacts of climate change in order to adapt to new circumstances using new information. Implementing an approach to biodiversity management based on flexible processes that ensure accountability can strengthen resilience to climate change in ecosystems and society. The resources available in ELI's Legal and Policy Tools to Adapt Biodiversity Management to Climate Change: A Resource Manual provide detailed options for designing a path forward. It is critical for today's policymakers to start building this future now.

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