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*Managing Adaptation: Developing
a Learning Infrastructure in the
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Chapter 4

Managing Adaptation: Developing a Learning Infrastructure in the United States' Federal System

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4.1 Introduction

Though there is much solid evidence that anthropogenic climate change has already had and will increasingly have substantial adverse effects on biota and ecological processes (Staudinger et al. 2012), the chief barrier to effective natural resource governance over the next few decades will likely be the exceptional uncertainty that accompanies attempts to adapt to the effects of climate change on natural systems. The global scale of climate change, the array and complex interaction of variables inherent in climate, and the limited study of its effects raise massive obstacles for effective climate regulation (Siegel 2009). Moreover, efforts at climate change adaptation (dealing with the inevitable effects of climate change) as compared to mitigation (that seeks to reduce greenhouse gas emissions to prevent further climate change) face yet another order of uncertainty. The various difficulties involved in ‘downscaling’ ecosystem modeling—localizing global projections down to a scale necessary to inform and assist adaptation efforts—raise uncertainty to a level that environmental regulators have never attempted to manage.

Consequently, the effective adaptation of natural resource management to climate change hinges on the development of a regulatory infrastructure that provides public and private actors the capacity to assess and manage uncertainty. This chapter briefly sketches the options originally considered for natural resource governance in the United States, their insufficiency in the key function of managing uncertainty, and how to build a more effective federal system for managing natural resources in preparation for climate change. Uncertainty underscores the value of regulatory experimentation and learning in a largely decentralized and overlapping federal system, and suggests a crucial role for national governments and

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international institutions of promoting agency learning and inter-jurisdictional information sharing.

4.2 Common Regulatory Models for Natural Resource Governance in the United States

4.2.1 *Rely on Specialized, Fragmented Decision-Making*

The paradigmatic approach to natural resource governance in the United States has been one of highly fragmented and overlapping authority, which has hindered agency action for adapting to climate change (Craig 2010). Natural resources agencies have typically been allocated limited authority to regulate or manage specific resource problems. As a result, natural systems in the United States are subject to an extensive patchwork of piecemeal management, divided based on the protected resource (e.g. water quality, water use, freshwater species, marine species, national park, national forest), the level of government, the branch of government, and the regulatory stage (Buzbee 2005). As one example, over 148 different federal programs involving ten federal agencies have been created to manage natural resources in the Great Lakes basin, not to mention the scores of local, state, and regional agencies within the United States, Canadian federal and provincial agencies, and international institutions with jurisdiction over the Great Lakes' natural resources (United States General Accounting Office 2003). Even intra-agency fragmentation is prevalent, with environmental agencies often consisting of fairly autonomous divisions and regional offices (Geltman and Skrobäck 1998). Thus, regulatory fragmentation is not just the allocation of authority between a national government and constituent states; it exists within each sovereign and even within individual agencies.

In addition to other potential critiques,¹ some scholars have pointed out that particularly for large-scale, broadly dispersed resource issues, regulatory fragmentation can have the effect of impeding beneficial regulatory action. Ruhl and Salzman (2010), for example, discuss the reticence of agencies to address complex problems, which, by their nature, cannot be completely addressed under the jurisdiction of a single agency. Even more so than mitigation activities, adaptation to climate change is a good example of such a collective action problem or 'regulatory commons' (Buzbee 2003). The causes and significant effects of climate change are widely recognized but cross a multitude of jurisdictional borders (Craig 2008), and federal adaptation strategies are more difficult to implement than mitigation

¹ These include claims that fragmented and overlapping governance can result in an inefficient lack of finality, poor regulator accountability (Schapiro 2005), and the potential for inefficient over-regulation when 'numerous regulators are confronted with a more particularized project or proposal with localized and discernible effects' (Buzbee 2005, p. 349).

strategies because they involve an even greater number and range of government authorities (United States Congressional Budget Office 2005). Because of a number of factors present in such a splintered regulatory setting—including the information costs of developing a regulatory response, likely diluted credit,² biases toward the regulatory status quo, and the risk aversion of regulators—isolated regulators have little incentive to proactively devote resources to gather information on or regulate to curtail the localized effects of global climate change (Buzbee 2003). With limited jurisdiction and information, government programs have little capacity to learn and adapt.

Indeed, reports have consistently concluded that natural resources institutions in the United States are still poorly equipped for climate change adaptation (Government Accountability Office [GAO] 2007, 2009, 2011; Intergovernmental Panel on Climate Change 2007; White House Council on Environmental Quality 2010; Pew Center on Global Climate Change [Pew Report] 2010). The United States Congress has yet to establish a comprehensive regulatory program directed at climate change adaptation, and for many years government agencies failed to engage in meaningful adaptation efforts. Increasingly, some federal and state resource agencies are finally investigating and beginning to develop adaptation plans and responses (U.S. Fish and Wildlife Service 2012; National Climate Assessment and Development Advisory Committee 2013; GAO 2013), but many remain modest, in draft form, or conceptual (GAO 2013; White House Council on Environmental Quality 2010; Pew Report 2010). Despite an initial increased emphasis on adaptation planning and funding (GAO 2011), resources have been cut (GAO 2013). Many agency activities continue to ignore adaptation, while many of those actions that address it focus on merely studying the problem and gathering information (GAO 2009, 2011). At least some state and federal officials have asserted that their narrow jurisdiction leaves them lacking the information or authority to engage in adaptation (GAO 2007, 2009, 2011).

4.2.2 Consolidate or Centralize ‘Substantive’ Decision-Making Authority

In response to the incentives toward inaction caused by regulatory fragmentation, a familiar response is to call for changes in natural resource governance that centralize decision-making authority (Fortney 2006; Buzbee 2003). Consolidation of decision-making might take any variety of forms. It might include a fundamental reassembly of regulatory authority, such as through federal preemption of state regulation in a particular field or the reorganization of fragmented authority. Examples of the latter include the creation of the United States Department of

²In fragmented regulatory contexts, a regulator has less incentive to act because credit will most likely be divided among all regulators (Buzbee 2003).

Homeland Security—in which a suite of federal agencies were combined and rearranged—or calls for the integration of United States intelligence-gathering responsibilities, which traditionally has been fragmented among many federal agencies (O’Connell 2006).

The centralization of authority might also involve a more restrained ‘partial de-fragmentation’. This might involve the consolidation of a couple of resource programs, or the establishment of substantive review by a central governmental authority (such as the President) of another’s functions (Buzbee 2003; Farber 2009). In any event, the intent is to consolidate substantive decision-making authority in fewer and more central institutions.

In the United States, some have recommended the consolidation of climate change adaptation planning power in the hands of a central federal authority. The most prominent example of a proposed partial integration was included in the only comprehensive climate change bill adopted to date by either chamber of the United States Congress—Waxman-Markey’s American Clean Energy and Security Act of 2009 (ACES).³ The ultimately unsuccessful bill sought to significantly increase executive oversight and control over both federal and state natural resource adaptation by consolidating authority in the President and Secretary of the Interior. ACES would have established ‘an integrated Federal program’ (ACES § 471) including a Natural Resources Climate Change Adaptation Panel headed by the Chair of the Council on Environmental Quality (CEQ), a division of the Executive Office of the President (ACES § 475). The Panel, which would have included the heads of federal public land and natural resources agencies, would be tasked with developing and implementing a National Resources Climate Change Adaptation Strategy (ACES § 476). Though ACES would not have adopted a more fundamental consolidation such as requiring a single federal agency to carry out all natural resource adaptation planning,⁴ it would have required the adoption of an adaptation plan by each federal natural resources agency that would implement and be consistent with the Strategy, as determined by the President (ACES § 478). The institution of more centralized strategic planning, combined with mandated executive review of individual agency plans, would have marked a substantial shift toward more centralized natural resource management in the United States.

The broadest adaptation initiative actually implemented in the United States to date, however, involves a much less centralized regime for adaptation planning. Under Presidential Executive Order 13514, the CEQ, Office of Science and Technology Policy, and National Oceanic and Atmospheric Administration (NOAA) were charged with co-chairing a federal Interagency Climate Change Adaptation Task Force, which included more than 20 Federal government agencies (White House Council on Environmental Quality 2010). White House CEQ Implementing

³ Though this bill was initially adopted by the House of Representatives, it was never adopted by the Senate.

⁴ In contrast, a less integrated structure might require each federal agency to develop an adaptation plan, but not require such plans to be consistent with a centralized adaptation strategy.

Instructions (2011b) required federal agencies to submit information to CEQ demonstrating that the agency is engaging in adaptation planning by a series of deadlines, and CEQ has collected and makes available draft adaptation plans developed pursuant to this process. This initiative thus provided the CEQ an (albeit limited) oversight role in adaptation planning by other federal agencies. Presidential Executive Order 13653 (2013) replaced this Task Force with the Council on Climate Preparedness and Resilience, which is comprised of 32 federal agencies directed, in coordination with the Council, to identify and remove or reform barriers that discourage climate resilience.

Increased centralization could include substantive limitations on the discretion of states to engage in adaptation activities as well. For example, ACES would not only have shifted responsibility for setting federal natural resource goals from Congress or individual federal agencies to the Panel, but also from states to the Panel. Any state that needed federal funding to assist it to adapt its natural resources to the effects of climate change would have had to submit an adaptation plan to the Secretary of the Interior, who could have disapproved the state plan if it deemed this plan to be inconsistent with any goal, priority, or standard established by the Panel under its broad authority to adopt a federal Strategy (ACES § 479). Though states would do much of the natural resource adaptation work, the big-picture decision-making would have been primarily federal.

However, as a growing number of scholars have reasoned, a more uniform approach that consolidates or closely integrates decision-making institutions may impede a number of the benefits of more decentralized governance. In addition to the implausibility of eliminating already extensive regulatory segmentation (Buzbee 2003; Ruhl 2010), many scholars have detailed the undesirability of doing so (Ruhl and Salzman 2010; Buzbee 2003; Adelman and Engel 2007; Schapiro 1999). While there may be benefits to reducing fragmentation in certain circumstances,⁵ a decentralized federal system may allow for a diversity of tailored approaches, promoting innovative management experimentation and creating the opportunity for learning about the advantages and disadvantages of particular management strategies (Adelman and Engel 2007). Initial local standards also can serve as a proving ground or can catalyze more centralized authorities to promulgate regulations (Engel 2006; Carlson 2009), ensuring regulatory progress in spite of pressures from special interest groups (Adler 2005). As stated by Adelman and Engel (2009): 'Adaptive federalism simultaneously sustains competitive legislation and administrative processes that promote the refinement of policies...and processes that produce a diverse range of policy options' (p. 290).

Some scholars also argue that the redundancy that occurs through multiple overlapping but independent jurisdictions can prevent 'group think', agency capture, and promote agency competition that may yield better outcomes than

⁵ For example, such a case might exist if there is directly conflicting or redundant authority by regulators without a discernable difference in subject matter competence. In addition, 'local research into health effects, safe exposure thresholds, and potential control strategies could be duplicative. Accordingly, such research may be conducted more efficiently at the federal level' (Adler 2005, p. 148).

coordination (O’Connell 2006, p. 290; Schapiro 2005). Designed correctly, concurrent jurisdiction also has the potential to improve management decisions by allowing a range of specialized subject matter competencies to be brought to bear on a resource problem. Furthermore, each regulatory authority can serve as an accountability check on the others.

A key endeavor for any framework for adapting to the effects of climate change in the United States, then, is promoting the management innovation and opportunities for learning associated with decentralized governance while reducing and overcoming the inefficiencies that create collective action problems (Adelman and Engel 2007). As stated by Adelman and Engel (2009): ‘The challenge is to maintain a process of optimization, which leads to specialization and efficiencies while cultivating a diversity of backup options in the wings’ (p. 290). Other related challenges include determining when redundancy serves as a valuable fail safe or merely an impediment to necessary action, and reconciling regulatory fragmentation’s potential for decreasing agency accountability to the public with its potential for increasing interagency accountability.

4.2.3 Create Regional Collaborative or Coordinating Networks

How can the United States’ federal system best accommodate these competing objectives? Some assert considerable benefits from inter-governmental competition (Adelman and Engel 2007), and decry the inefficiencies that come with too much coordination (O’Connell 2006). Many, however, have emphasized the value of agency dialogue and collaboration. Various natural resources scholars (Bardach 1998; Ruhl and Salzman 2010) and regulatory officials (U.S. Climate Change Science Program 2008) have called for the development of networks that promote interagency collaboration and coordination. Proponents of these decentralized regional institutions emphasize the need to focus resource management on regulatory linkages around particular ecosystems or landscapes (Grumbine 1994; Karkkainen 2008). Rather than combining institutions or providing one government authority substantive oversight of another, the aim of these regional or ecosystem-based institutions is to serve as a venue for agencies to discuss and possibly coordinate regulatory activity. The expectation is that such opportunities for communication and synchronization will reduce the effects of fragmentation without resort to the consolidation of decision-making authority.

Though varying in structure, a wide number of inter-jurisdictional governance experiments have been adopted in the United States. A few examples include the Great Lakes Regional Collaboration (<http://www.glrc.us/>), the Chesapeake Bay Program (<http://www.chesapeakebay.net/index.aspx>), and California’s Natural Community Conservation Planning Act (2001). In fact, at present most natural resources in the United States are managed not only through a number of local,

state, and national authorities, but also regional intergovernmental networks offered as venues for agency collaboration and cooperation.

Perhaps unsurprisingly, then, some initiatives by the federal government have been created to serve as a coordinating network for addressing climate change adaptation. The Interagency Climate Change Adaptation Task Force and Council serve as collaborative and coordinating venues for federal agencies on climate change adaptation planning. Other than the CEQ ensuring compliance with planning deadlines, federal agency participants in the Task Force did not have substantial direct oversight or authority over others on adaptation activities. The Task Force served primarily as a venue for Federal agencies to communicate, brainstorm, and develop recommendations for the President on potential federal adaptation strategies (White House Council on Environmental Quality 2010). The Task Force has developed work groups and listening sessions with stakeholders and experts, including state and local authorities, about what might be needed for adaptation policy. Pursuant to these efforts, agencies are developing climate assessments and beginning to formulate adaptation plans (GAO 2013). Similarly, the United States Department of Interior has formed 22 regional landscape conservation cooperatives to help local, state, tribal, regional, national and international authorities to begin to coordinate adaptation planning regarding ecological resources (U.S. Fish and Wildlife Service 2012). Under the Task Force, Council, and Interior initiatives, however, individual agencies develop their own adaptation plans.

4.3 How Prevailing Models Fail to Manage Uncertainty

Unfortunately, the countless attempts to establish inter-jurisdictional networks in the United States have generally made slow and limited progress in overcoming the negative effects of fragmented governance. This is in large part because such experiments, like other past approaches for managing overlapping authority, have paid insufficient attention to the need to cultivate both interagency information sharing and agency learning in the regulatory process. Without these two inter-related features, the existing federal system governing natural resources in the United States does a poor job managing uncertainty.

First, most network-based attempts to reduce the effects of fragmentation have provided at best weak opportunities and incentives for inter-jurisdictional information sharing and collaboration. These regulatory experiments seem to neglect the fact that regulatory inaction is largely a symptom of a bigger problem—the significant barrier to intergovernmental learning created by fragmented governance. Many agencies must cope with longstanding and widespread gaps in the collection and management of scientific information relevant to regulatory decision-making, including data sets that are incomplete, obsolete, or missing information, and difficulties in managing the data that are available (Adler 2005).

This is compounded by the fact that agency officials typically lack access to any analyses or management strategies employed by other agencies, or even those by other regional offices or divisions in the same agency (Karkkainen 2004). Regional collaborations may provide the opportunity to interact with and perhaps learn from a few other regulators on a common resource problem; but such networks rarely set up systematic opportunities for information sharing within a collaboration (let alone more broadly). Consequently, existing regional efforts have too often served as yet another layer of fragmentation to the already disjointed regulatory landscape.

Because much existing information is not readily available, regulators are unable to draw systematically from the experience of other regulators and reduce uncertainty about the efficacy of particular strategies in addressing regulatory goals. Failing to harness the collectively available information and experience leaves regulators isolated and natural resources susceptible to regulatory gaps (Craig 2010). Ultimately, the existing regulatory framework provides little prospect for managing the large-scale effects and considerable uncertainty to follow from climate change. The fact that climate change effects on natural resources until recently have been virtually ignored by this vast array of regulators, including those regional networks specifically tasked with reducing the effects of fragmentation, is telling.

Secondly, most existing natural resource programs in the United States fail to encourage managers and regulators to learn methodically how to manage uncertainty and make resource management progressively more effective at achieving program goals. Regulatory programs are not designed to provide sufficient pressure on resource managers to work with and reduce uncertainty by systematically assessing and adjusting management approaches. In response to numerous critiques of agencies for failing to develop resource management strategies that were enduring and capable of adjusting to new information or changed circumstances, natural resources agencies have increasingly adopted experimental protocols designed to make resource management more adaptive (Camacho 2007). However, even these *adaptive management* innovations have not been structured to require or otherwise pressure managers to learn systematically from their own management experience (Gregory et al. 2006).⁶ These experiments also fail to require or provide other incentives for regulators to learn from the activities of similarly situated officials in the same or other agencies. In essence, both conventional fragmented regulation and existing regulatory experiments have failed to cultivate the systemic capacity to manage uncertainty through learning.⁷

⁶ Evaluations of collaborative governance experiments have found that scarce information about ecological processes, management strategies, and agency performance contributes greatly to failure by collaborative experiments (Karkkainen 2008).

⁷ For a more detailed critique of the capacity of existing regulatory programs in the United States to engage in adaptive learning, see Camacho (2009).

4.4 Integrate Data Gathering and Standardize Adaptive Governance

A governance model can respond to these criticisms and seek to manage uncertainty by leaving decision-making decentralized but creating a network and consistent framework for information generation, gathering and dissemination. This would include creating a shared, easily accessible, adaptive, and interactive infrastructure that promotes inter-jurisdictional information sharing on projected environmental effects (including those from climate change) and potential management strategies (Camacho 2011). A searchable repository would help managers draw from a broader set of environmental data and analyses on the performance of management strategies in diverse contexts (DiMento and Ingram 2005). However, drawing on recent developments in virtual modes of collaboration, an adaptive and collaborative learning infrastructure should move beyond the simple formation of a data clearinghouse to form more interactive and adaptive virtual environment for creating and disseminating information relevant to climate change adaptation (Camacho 2011).

This model would lodge the fairly limited function of information coordination with a central authority (such as the United States Library of Congress or the CEQ) while allowing for resource management decisions to remain with each agency delegated authority over a particular resource. Only requiring information flow between resource managers accommodates many of the core benefits of decentralized governance, neither requiring agency consolidation nor agreement on a particular strategy by all regulators with jurisdiction. As such, making such information available is valuable whether agencies engage in collaborative efforts or in competition.⁸ This approach is likely to be particularly useful for problems like climate change adaptation, given the localized character of climate effects but the considerable benefits to individual regulators of information-pooling (Salkin 2010).

Allowing regulators to tap a broader scientific data set and management experience helps curtail uncertainty, impediments to learning, and collective-action problems that result from regulatory fragmentation. Through such a framework, regulators could better learn from the successes and mistakes of other regulators in their management of natural resources. In addition, regulators would serve as sources of external pressure on other regulators to engage in monitoring, reporting, and adjustment of adopted strategies. In this manner, innovations that promote information-pooling and inter-jurisdictional communication could enrich agency decision-making and decrease incentives for regulatory inaction.

The federal Interagency Climate Change Adaptation Task Force has called for the creation of “an online interagency global change information portal/system to

⁸ ‘The complex scientific underpinnings of many environmental challenges favor allocation of research and information sharing functions to the federal government. Even if inter-jurisdictional competition is viewed as a good, one can embrace allocation of such information-gathering functions to federal actors’ (Buzbee 2005, p. 353).

provide ‘one-stop shopping’ for climate-related information” (White House Council on Environmental Quality 2011a). Despite such recommendations, no comprehensive portal has been launched, though after several years a limited beta version of an interagency portal system has been demonstrated (White House Council on Environmental Quality 2011a, b) and there are disparate government sites that collect selected government climate data (U.S. Global Change Research Program 2013; GAO 2013). Moreover, the Task Force unfortunately has ignored the growing cyber-technology on collaborative learning and has yet to provide an adequate infrastructure to promote such information sharing (Camacho 2011). Encouragingly, the new Presidential Executive Order 13653 (2013) has mandated the development and provision of data and decision-support tools on climate preparedness and resilience, as well as the establishment of a web-based portal for disseminating such information.

A small-scale and incomplete example of a clearinghouse focused on climate change was established by the United States Environmental Protection Agency (EPA) as part of its National Estuaries Program. The National Estuaries Program focuses on promoting intergovernmental collaboration on estuarine management, but it had not created any systematic way for regional estuaries or constituent agencies to share information or learn from others. However, in 2008 the EPA established the Climate Ready Estuaries program, including a pilot ‘coastal toolkit’ that collected a range of internet links and documents to aid estuaries in identifying vulnerabilities to, and adaptation planning for, climate change (Climate Ready Estuaries n.d.).⁹ Nonetheless, this coastal toolkit is very limited in scope and provides few opportunities for collaborative learning (Camacho 2011). Similarly, the United States Geological Survey (2008) founded a National Climate Change and Wildlife Science Center, including eight regional climate science centers. The hope is that these centers will help synthesize climate information, help other agencies develop adaptive management strategies, and facilitate partnerships. The focus of these efforts is not on the assessment of management strategies but rather on developing scientific information on the effects of climate change on resources.

The ACES bill would have improved on existing environmental agency information gathering by requiring periodic vulnerability assessments, plans and strategies on climate change adaptation, and establishment of a National Climate Service in NOAA to coordinate with the United States Geological Survey’s National Climate Change and Wildlife Science Center to create a process for developing and providing science and information to assess and address the impacts of climate change on natural resources (ACES 2009). The ACES bill would also have required the National Climate Service to initiate and maintain a clearinghouse that included information on projected climate change, the effects of such climatic changes, and possible adaptation strategies, including hyperlinks to resources on the internet (ACES 2009). Though this information-gathering and dissemination

⁹ The pilot program also designates six NEP estuaries for targeted technical support from EPA, and intermittently hosts workshops that assemble officials with jurisdiction over estuaries to discuss adaptation planning (Climate Ready Estuaries 2010).

framework itself might have been fragmented and thus prone to the same regulatory gaps that management agencies are, it nonetheless would have been an improvement on the minimal information infrastructure that currently exists for natural resource governance in the United States.

Nonetheless, a clearinghouse is only as useful as the information that it includes. To truly promote intergovernmental learning on resource management, a clearinghouse would have to include information that today is rarely even generated by resource agencies—systematic data on the past performance of management strategies in accomplishing regulatory goals. Like other clearinghouses, neither the Climate Ready Estuaries toolkit nor the now-defunct ACES bill required the collection and incorporation of systematic evidence on management strategies and programs. Similarly, the National Climate Change and Wildlife Science Center does not appear to contemplate developing and incorporating regular and on-going data on the performance of management strategies and agencies. Though the Interagency Climate Change Adaptation Task Force does advise agencies to share and adaptively manage information for adaptation planning, it ignores the lessons of prior uses of adaptive management and does not require concrete triggers for or otherwise incentivize agencies to engage in continued assessment and adjustment of management decisions (Camacho 2011).

Accordingly, Congress should also adopt an *adaptive governance* framework in which Congress defines clear goals and targets for adaptation, and requires agencies to regularly monitor, assess, and adjust adopted management strategies based on their performance toward such goals and targets. By combining this framework with a robust and coordinated clearinghouse, adaptive governance would proliferate opportunities for information sharing and cultivate learning. This in turn should help reduce the barriers to regulation exacerbated by uncertainty. Furthermore, providing a transparent means for assessing agency progress toward regulatory goals would help promote more effective agency decision-making and serve to make agencies more accountable to legislatures and the public.¹⁰

4.5 Conclusion

Established models of federalism reasonably contemplate dispersed and overlapping authority as vital to cultivating diversity, innovation, and ultimately more effective regulation. However, conventional natural resource regulation in the United States is poorly designed to promote these potential benefits, leaving resource managers isolated in addressing uncertain regulatory problems and failing to pressure regulators to learn. Prevailing responses for addressing this shortcoming seek either to consolidate or create venues for promoting collaborative decision-making, but these approaches have insufficiently attended to the core challenge of

¹⁰For a more comprehensive delineation of such an inter-jurisdictional adaptive governance framework, see Camacho (2009, 2011).

reducing and managing uncertainty. In short, natural resource managers and policy-makers not only lack information about future effects and the value of management strategies in particular contexts, they also lack the infrastructure to gain such information.

Unfortunately, few emerging adaptation strategies in the United States adequately seek to alter the existing federal system to provide private and public actors the capacity and incentive to manage the uncertainties of climate change. Even the most robust federal legislative proposals and regulatory actions to date in the United States largely ignore agency learning and accountability. They fail to articulate goals against which agencies would have to assess the performance of adopted plans, hindering the capacity for agencies (and others) to evaluate the effectiveness of adopted strategies. To induce more effective natural resource governance, the United States Congress must establish and refine a shared information framework that creates, collects, and disseminates information on management strategies and the environment. Such a concurrent federal system can reduce the barriers to effective action, cultivate a diverse range of management options that facilitates collective learning, and help reduce uncertainty and manage the effects of climate change.

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