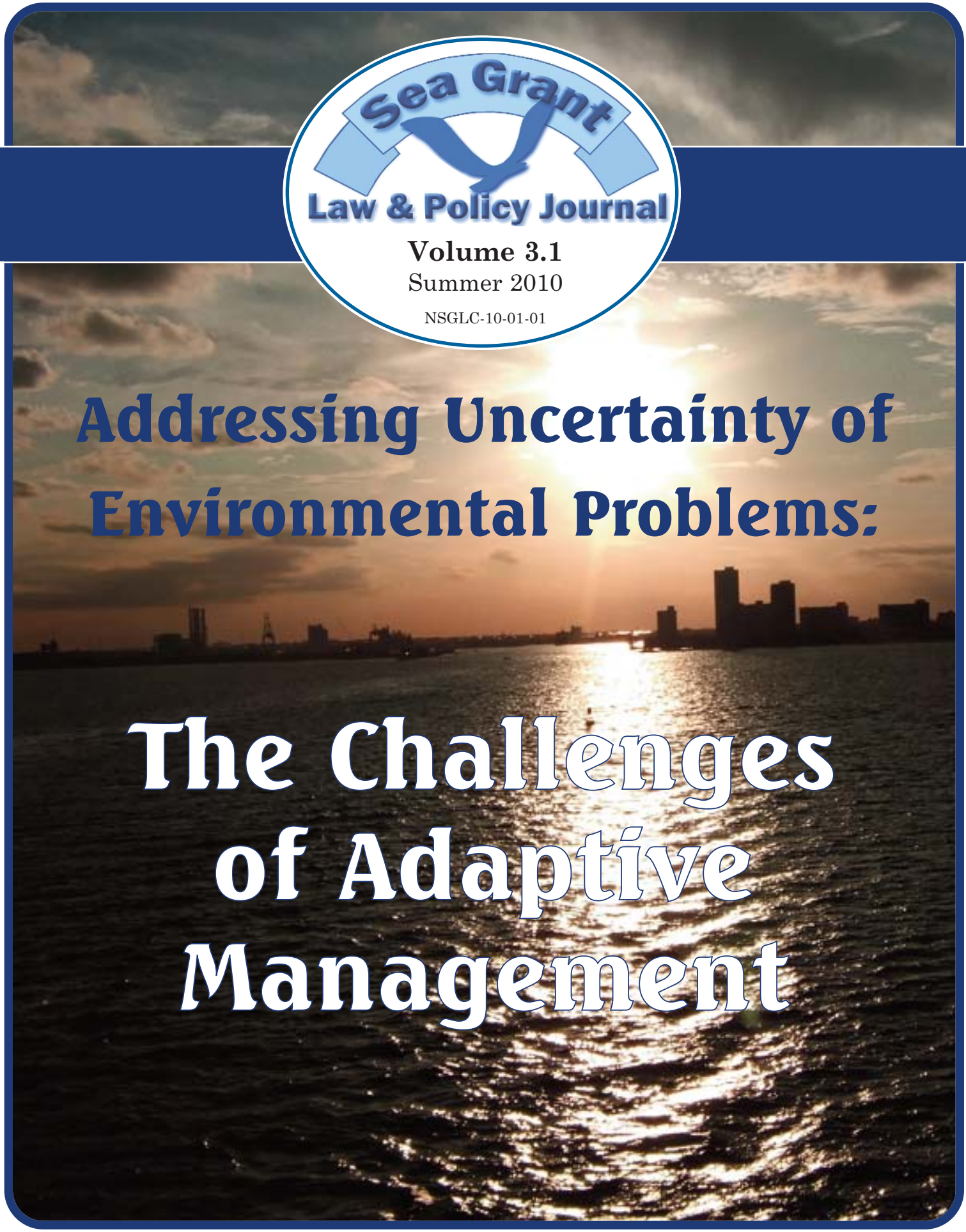

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Addressing Uncertainty of Environmental Problems:

The Challenges of Adaptive Management

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Parting Thoughts from the *Sea Grant Law and Policy Journal*'s 2010 Symposium on Adaptive Management

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Abstract: The third annual Sea Grant Law and Policy Journal *symposium was held at the University of Mississippi School of Law in Oxford, Mississippi on March 30 - 31, 2010. During the two-day event, legal scholars, practitioners, and scientific experts explored the challenges associated with implementing adaptive management frameworks for a range of environmental problems in the United States and the United Kingdom. In this article, Terra Bowling, Research Counsel for the National Sea Grant Law Center, provides an overview of the theory of adaptive management and discusses some of the major barriers to implementation in the United States.*

I. Introduction

In 2009, the White House Council on Environmental Quality (CEQ), the Office of Science and Technology Policy (OSTP), and the National Oceanic and Atmospheric Administration (NOAA) formed the Interagency Climate Change Adaptation Task Force to develop U.S. strategy for adaptation to climate change.[2] In October 2009, President Obama signed the Executive Order on Federal Leadership in Environmental, Energy, and Economic Performance, which called for the Task Force to develop, within one year, Federal recommendations for adapting to climate change impacts both domestically and internationally.[3]

As evident in the formation of the Task Force and the ensuing executive order, an adaptive approach to natural resource management is frequently cited as the key to solving complicated environmental problems like climate change. More flexible than a traditional regulatory approach, adaptive management "calls for more experimentalism in regulatory implementation."[4] More specifically, "[u]nder adaptive management, regulators use models of natural resource systems to develop performance measurements and initial policy

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[2] White House Council on Environmental Quality, Climate Change Adaptation Task Force, http://www.whitehouse.gov/administration/eop/ceq/initiatives/adaptation (last visited July 28, 2010).

[3] Exec. Order No. 13,514, 74 Fed. Reg. 52,117 (Oct. 8, 2009).

[4] J.B. Ruhl, *Symposium: Reforming Environmental Law: Can Regulation Be More Adaptive?: Taking Adaptive Management Seriously: A Case Study of the Endangered Species Act*, 52 KAN. L. REV. 1249, 1249 (2004).

choices, but they build into the regulatory implementation framework a process for continuous monitoring, evaluation, and adjustment of decisions and practices."[5] Essentially, adaptive management allows natural resource decision-makers to adjust management regimes to reflect the changing scientific understanding of environmental problems. In his keynote address at the National Sea Grant Law Center's *Sea Grant Law and Policy Journal* 2010 Symposium entitled "Addressing Uncertainty of Environmental Problems: The Challenges of Adaptive Management," Alejandro Camacho suggested that an adaptive governance framework for climate change would promote agency learning and accountability, help manage uncertainty, and reduce the likelihood and magnitude of mistakes expected to come with facing such an exceptional problem with initially imprecise tools.[6]

Despite the expected benefits of an adaptive management approach, a number of significant legal and administrative barriers may hinder the effective implementation of adaptive management regimes. For example, regulatory fragmentation inhibits the implementation of adaptive management regimes, as one resource may be regulated among many local, state, national, and international authorities.[7] And perhaps most daunting, adaptive management regimes face institutional constraints as well as opposition from those who fear a change in the "front-end" approach to managing natural resources.[8] This paper will give an overview of adaptive management, including a look at adaptive management in practice and barriers to implementation.

II. Adaptive Management Theory

The concept of adaptive management may be traced to the works of C.S. Holling and Carl Walters in 1978 and 1986, respectively.[9] Holling was among the first to suggest integrating the concept of resilience into policy, rather than relying on environmental assessment.[10] Walters "described adaptive management as a way to deal with scientific uncertainty when managing renewable resources…"[11]

Traditional environmental law identifies environmental stressors and relies on prescriptive regulation to protect natural resources.[12] For example, regulations might target emissions from smokestacks to protect air quality. However, problems without easily identifiable sources, such as the effects on waterbodies from fertilizer runoff from thousands of miles away, may be too complex for the prescriptive regulation model.[13] "The need for an adaptive

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[5] *Id.* at 1249-50.

[6] For more information on Alejandro Camacho's research in this area, *see* Alejandro E. Camacho, *Adapting Governance to Climate Change: Managing Uncertainty through a Learning Infrastructure*, 59 EMORY L.J. 1 (2009).

[7] *Id.* at 5.

[8] J.B. Ruhl, *It's Time to Learn to Live With Adaptive Management (Because We Don't Have a Choice)*, 39 ENVTL. L. REP. 10920, 10920 (2009).

[9] Mary Jane Angelo, *Resilience and Environmental Law Reform Symposium: Stumbling Toward Success: A Story of Adaptive Law and Ecological Resilience*, 87 NEB. L. REV. 950, 953 (2009).

[10] *Id.*

[11] *Id.*

[12] J.B. Ruhl, *Regulation by Adaptive Management—Is it Possible?* 7 MINN. J.L. SCI. & TECH. 21, 21 (2005-2006).

[13] *Id.* at 25.

approach to management became apparent in light of new understanding of ecosystems as dynamic, rather than as having only one equilibrium state. Since then, government agencies have been trying to account for the disparity between science and environmental law and formulate a system that can adjust to confront scientific uncertainty."[14]

Many government agencies have sought to define and integrate an adaptive management approach. For example, adaptation is defined by the Intergovernmental Panel on Climate Change as "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities."[15] The Adaptive Management Technical Guidance from the U.S. Department of the Interior defines adaptive management as "a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process … It is not a 'trial and error' process, but rather emphasizes learning while doing."[16] The National Research Council branch of the National Academy of Sciences identified eight steps for implementing adaptive management: (1) definition of the problem; (2) determination of goals and objectives for management of ecosystems; (3) determination of the ecosystem baseline; (4) development of conceptual models; (5) selection of future restoration actions; (6) implementation and management actions; (7) monitoring and ecosystem response; and (8) evaluation of restoration efforts and proposals for remedial actions.[17]

Camacho suggests that an adaptive governance framework that requires agencies to systematically monitor and adapt their decisions and programs, as well as interagency information sharing, will help with complex environmental problems like climate change.[18] He suggests that this learning infrastructure would promote agency learning and accountability, help manage uncertainty, and reduce the likelihood and magnitude of mistakes expected to come with facing such an exceptional problem with initially imprecise tools.

III. Adaptive Management In Practice

While many federal agency regulations and policies call for adaptive management, scholars have noted that regulatory guidance on how to implement the theory is scarce.[19] "The theory of adaptive management—what is meant by the words—is quite well established. It

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[14] Angelo, *supra* note 9.

[15] INTERAGENCY CLIMATE CHANGE ADAPTATION TASK FORCE, PROGRESS REPORT 1 (Mar. 16, 2010), *available at* http://www.whitehouse.gov/sites/default/files/microsites/ceq/20100315-interagency-adaptation-progress-report.pdf .

[16] U.S. DEP'T OF THE INTERIOR, ADAPTIVE MANAGEMENT TECHNICAL GUIDE 4 (2009), *available at* http://www.doi.gov/initiatives/AdaptiveManagement/TechGuide.pdf .

[17] Ruhl, *supra* note 8, at 10920-21 (citing COMM. ON ENDANGERED AND THREATENED FISHES IN THE KLAMATH RIVER BASIN, BD. ON ENVTL. STUDIES AND TOXICOLOGY, DIV. ON EARTH & LIFE STUDIES, NATIONAL RESEARCH COUNCIL, ENDANGERED AND THREATENED FISHES IN THE KLAMATH RIVER BASIN: CAUSES OF DECLINE AND STRATEGIES FOR RECOVERY (2004)).

[18] Camacho, *supra* note 6, at 1.

[19] *Id.*

is the practice of adaptive management—what to do to make those words come true—that has been far more elusive to get on the page."[20] Another academic noted that "Unfortunately, although numerous examples exist where resource agencies adopted adaptive management policies, at least in name, as part of a variety of environmental management and/or restoration projects, examples of successful adaptive management are hard to find."[21]

One of the first instances of adaptive management implementation in resource management is the Columbia River Basin Fish and Wildlife Program. Hydropower development in the river basin had resulted in damage to the region's fish and wildlife. After several Snake River salmon populations were listed as endangered, Congress passed the Pacific Northwest Electric Power Planning and Conservation Act in 1980.[22] The Act established the Pacific Northwest Electric Power and Conservation Planning Council, which required the council to develop a program to protect fish and wildlife while treating the river and its tributaries as a "system." The Council adopted an adaptive management policy in its action plan, noting that adaptive management "recognizes biological uncertainty, while accepting the congressional mandate to proceed on the basis of the 'best available scientific knowledge.'"[23]

Following the Columbia River Basin program, several federal and state agencies have adopted adaptive management methods. At the Symposium, Lance Gunderson of the Department of Environmental Studies at Emory University presented "Scientific Underpinnings of Adaptive Management and Adaptive Governance."[24] In his presentation, Gunderson used the examples of adaptive management approaches in two ecosystems, the Colorado River in the Grand Canyon and the Florida Everglades. He explained that adaptive forms of experimentation and governance are needed in these large complex ecosystems to resolve chronic resource issues and achieve restoration goals.

The Department of the Interior created the Glen Canyon Adaptive Management Program after an Environmental Impact Statement in 1995 recommended adaptive management as a way to mitigate environmental impacts and comply with federal law.[25] The Dam had altered the flow of the river, which resulted in decreased sediment deposits that build canyon beaches, decreased river temperature, and fluctuating releases of water which threatened indigenous fish, some of which were listed as endangered species.[26] The Plan employs an advisory committee review panel, as well as the Technical Working Group, the Grand Canyon Monitoring and Research Center, and Independent Review Panels.[27] The

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[20] *Id.*
[21] Angelo, *supra* note 9.
[22] 16 U.S.C. §§ 839-839h.
[23] Angelo, *supra* note 9 (citing Kai N. Lee & Jody Lawrence, *Adaptive Management: Learning from the Columbia River Basin Fish and Wildlife Program*, 16 ENVTL. L. 431, 440-41 (1986)).
[24] A video of Lance Gunderson's presentation and his PowerPoint slides can be accessed at http://nsglc.olemiss.edu/SGLPJ/symposium10.htm .
[25] BUREAU OF RECLAMATION, U.S. DEP'T OF THE INTERIOR, FINAL ENVTL. IMPACT STATEMENT FOR OPERATION OF GLEN CANYON DAM, COLO. RIVER STORAGE PROJECT, ARIZ. 34-38 (1995).
[26] Angelo, *supra* note 9, at 956-57.
[27] Lawrence Susskind, et al., *Collaborative Planning and Adaptive Management in Glen Canyon: A Cautionary Tale*, 35 COLUM. J. ENVTL. L. 1, 4 (2010).

adaptive management approach has allowed the agencies to experiment with flow regimes and comply with the National Environmental Policy Act's Environmental Impact Statement requirement.[28] For the most part, the Glen Canyon Program has been considered a success.

> Glen Canyon Dam offers an ideal opportunity for the systematic application of collaborative adaptive management, especially since scientific uncertainty and disagreements have been central to the ongoing acrimony among stakeholders. If implemented effectively, [collaborative adaptive management (CAM)] can lead to more sustainable management of natural resources and increase public support for whatever tradeoffs have to be made among ecological, economic development, and social welfare objectives. By bringing all parties to the table, more information—including a clearer presentation of the risks associated with managing the area's resources—can be obtained. When trust is fostered, parties are more open to searching for ways of meeting the interests of others rather than simply fighting for their personal interests. CAM can encourage careful review of how previous management efforts have and have not worked.[29]

Efforts at adaptive management in the Florida Everglades have been less successful.[30] In 1988, several scientists, including Gunderson, helped run a series of adaptive environmental assessment workshops in which they determined that restoration of the Florida Everglades was possible, despite significant degradation.[31] Federal and state governments have attempted to build on these efforts. In 1996, Congress authorized the South Florida Ecosystem Restoration Task Force and directed the Corps of Engineers to develop "a proposed comprehensive plan for the purpose of restoring, preserving, and protecting the South Florida ecosystem."[32] The Corps recommended the Comprehensive Everglades Restoration Plan (CERP) to fight, among other problems, wetlands loss and declining populations of species. Congress adopted the plan in the Water Resources Development Act of 2000.[33]

Despite these efforts, "implementation of restoration projects has been exceedingly slow."[34] While the CERP contains adaptive management principles, "the jury is still out on restoration accomplishments."[35] According to Zellmer and Gunderson, there are two primary criticisms: "the CERP devotes too much attention to the use of ever more heroic engineering techniques to expand water supplies and ensure flood control for South Florida's exploding population" and too much emphasis is placed on maintaining

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[28] Angelo, *supra* note 9, at 956-957.
[29] Susskind, *supra* note 27, at 5-6.
[30] *See*, Sandi Zellmer and Lance Gunderson, *Why Resilience May Not Always Be a Good Thing: Lessons in Ecosystem Restoration from Glen Canyon and the Everglades*, 87 NEB. L. REV. 893 (2009); Lance H. Gunderson and Stephen S. Light, *Adaptive Management and Adaptive Governance in the Everglades*, POLICY SCIENCES 39(4): 323-334 (2006).
[31] Zellmer and Gunderson, *supra* note 30, at 917.
[32] *Id.* at 917-18.
[33] Water Resources Development Act of 2000, Pub. L. No. 106-541, § 601, 114 Stat. 2572, 2680 (Dec. 11, 2000).
[34] Zellmer, *supra* note 30, at 918.
[35] *Id.* at 921.

stakeholders' economic interests, "which place a chokehold on experimentation, learning, and adaptation."[36]

IV. Barriers to Implementation

Why are agencies hesitant to put the theory of active adaptive management into practice? "It is because as a practical matter they are not truly expected or allowed to."[37] Governments "continue to command agencies to practice adaptive management, yet keep the agencies' hands tied in the ropes of conventional administrative process."[38] J.B. Ruhl stated that, "The problem is that adaptive management is not just an option anymore; it has become a necessity."[39]

Some legal scholars have questioned its necessity. Oliver Houck argued that adaptive management is not a solution for all environmental problems, "The most obvious place it does not belong is with planning for large public works and resource extraction projects that have identifiable environmental impacts that need to be assessed as fully as possible up-front, in order to make rational choices among modes, locations, and alternatives… On the other hand, where government action proposes a more experimental target such as restoring an ecosystem, or a species, there is a legitimate case for flexibility in getting there."[40]

Despite the debate over the need for adaptive management, its implementation does face very real barriers. First, there is the barrier of overcoming a "business as usual" approach. According to J.B. Ruhl, some of the criticisms of adaptive management include arguments that:

- Agencies will defer the "tough" decisions for later in promises of adaptive management, but then never make them.
- Agencies will truncate public participation and ignore public input.
- Agencies will enjoy and exercise unbounded discretion beyond the reach of judicial review.
- Agencies will collaborate in loose networks so as to hide accountability.
- Agencies will parse decisions into smaller units, making it difficult to identify which decision to challenge in court.
- Agencies will not rely on sound science and robust data.
- Agencies will operate as central planning science elites.[41]

Ruhl notes that these are legitimate concerns, but they are not new and traditional regulatory models are not working. He also cites political maneuvering as a source of the criticisms.

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[36] *Id.*
[37] Ruhl, *supra* note 8, at 10921.
[38] *Id.*
[39] *Id.*
[40] Oliver A. Houck, *Nature or Nurture: What's Wrong and What's Right With Adaptive Management*, 39 ENVTL. L. REP. 10923 (2009).
[41] Ruhl, *supra* note 8, at 10921.

As Gunderson noted, "The highly political nature of many regulatory decisions can be a significant impediment to adaptive measures."[42] As a result, "decision-makers can be reluctant to experiment and take advantage of feedback loops for fear of resistance from vested interests."[43]

Regulatory fragmentation presents another barrier. For example, Alejandro Camacho argued that existing fragmented governance is poorly equipped to deal with the challenges of adapting to the effects of climate change. "In such a splintered regulatory setting, private demands for government action are split among various potential regulators. Regulators who act early are likely to receive diluted credit as other regulators free ride on their efforts while status quo biases and risk aversion create additional incentives for regulatory inaction. Regulators thus have little incentive to devote resources to gather information on—or regulate the risks of—global climate change."[44] Other regulators have cited limited jurisdiction as a reason to ignore climate change.[45]

As Zellmer and Gunderson noted, adaptive management may be hindered by legal obstacles posed by federal laws, such as the Endangered Species Act, which requires consultation for all discretionary federal actions that may adversely affect a listed species or its critical habitat. "Adaptive management requires sufficient flexibility in applicable management mandates and sufficient resilience in ecological resources in order to experiment. Endangered or threatened taxa do not have such resilience and so it is difficult to conduct experiments in which the outcome can just as easily cause further endangerment as it can result in recovery."[46]

At the Symposium, Andrew Long, Assistant Professor of Law at Florida Coastal School of Law, cited the Columbia River Basin Fish and Wildlife Program "as a cautionary tale of the limits of adaptive management."[47] He stated that institutional constraints have proven nearly insurmountable obstacles to the experimentation and monitoring necessary to fully implement the adaptive management approach. Long argued that instead of focusing on the management of the fishery, attempts at adaptive management have resulted in continual efforts to build public support and stakeholder agreement. Gunderson noted similar issues with implementing adaptive management in the Everglades.

V. Conclusion

What will successful adaptive management look like? According to Ruhl, "It will be a structure in which interest groups participate rather than maneuver for litigation, in which

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[42] Zellmer and Gunderson, *supra* note 30, at 946.
[43] *Id.* at 946-47.
[44] Susskind, *supra* note 27, at 28.
[45] *Id.* (citing U.S. GOV'T ACCOUNTABILITY OFFICE, CLIMATE CHANGE, AGENCIES SHOULD DEVELOP GUIDANCE FOR ADDRESSING THE EFFECTS ON FEDERAL LAND AND WATER RESOURCES at 156, 159, 163, 167 (2007) (conveying comments by various officials regarding their agencies' limited capacity to respond to climate change)).
[46] Zellmer, *supra* note 31, at 947.
[47] Andrew Long, *Adaptive Management of Salmon in the Columbia River Basin*, presentation given at the *Sea Grant Law and Policy Journal* Symposium: Addressing Uncertainty of Environmental Problems: The Challenges of Adaptive Management, March 31, 2010, Oxford, MS, *available at* http://nsglc.olemiss.edu/SGLPJ/symposium10.htm .

agencies can make mistakes and not be crucified, and in which courts act as referees not police."[48]

On March 16, 2010, the Task Force released an Interim Report on its progress and recommended six key components to include in a national strategy on climate change adaptation: (1) Integration of Science into Adaptation Decisions and Policy; (2) Communications and Capacity-building; (3) Coordination and Collaboration; (4) Prioritization; (5) A Flexible Framework for Agencies; and (6) Evaluation. Now, the test is to put the definition into action. As mentioned above, adaptive management faces many barriers, but a "continuing commitment to adaptive management is critical in achieving restoration success."[49]

[48] Ruhl, *supra* note 8, at 10922.
[49] Zellmer, *supra* note 30, at 928.

The Adaptive Management Experience of the National Marine Sanctuaries Program

Lindsey Etheridge, Terra Bowling, and Stephanie Showalter Otts[1]

Abstract: The purpose of the National Marine Sanctuaries Act is "to identify and designate as national marine sanctuaries areas of the marine environment which are of special national significance and to manage these areas as the National Marine Sanctuary System." The National Marine Sanctuaries Program, within the National Oceanic and Atmospheric Administration, strives to adaptively manage these protected areas to address historic and emerging threats. This article summarizes the Program's adaptive approach to management, which includes proactive decision-making, a firm commitment to public participation, and the use of best-available science. Case studies from the Florida Keys National Marine Sanctuary and the Cordell Bank, Gulf of the Farallones, and Monterey Bay National Marine Sanctuaries illustrate how adaptive management principles are implemented at the local sanctuary level.

I. Introduction

In July, President Obama signed an Executive Order establishing a National Policy for the Stewardship of the Ocean, Coasts, and Great Lakes. The process of creating this national policy began on June 12, 2009, when President Obama established an Interagency Ocean Policy Task Force (Task Force) to be led by the Chair of the Council on Environmental Quality (CEQ) and composed of senior policy-level officials. The Task Force was charged with developing recommendations for, among other things, "a national policy that ensures the protection, maintenance, and restoration of the health of ocean, coastal, and Great Lakes ecosystems and resources" and that "provides for adaptive management to enhance

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our understanding of and capacity to respond to climate change."[2]

The CEQ issued the *Final Recommendations of the Ocean Policy Task Force* on July 19, 2010,[3] and immediately afterwards, the President signed Executive Order 13547. The Executive Order adopted the Task Force's final recommendations and created a National Ocean Council to enhance ocean governance and coordination between federal and state agencies. The Executive Order also established guiding principles for ocean management and adopted a flexible framework for effective coastal and marine spatial planning. Coastal and marine spatial planning is a comprehensive, adaptive approach to issues of conservation, economic activity, user conflict, and sustainable use of the ocean, coasts, and the Great Lakes. These plans will "build upon and improve existing Federal, State, tribal, local, and regional decision-making and planning processes."[4]

An important component of this new marine spatial planning process will be the National Marine Sanctuary System. National marine sanctuaries are nationally significant, underwater areas that are designated for the protection and conservation of marine life and resources within those areas. The National Marine Sanctuary System consists of 13 national marine sanctuaries, which vary greatly in size, shape, and resources protected. The smallest sanctuary is less than one square mile, while the largest is over 137,000 square miles. Sanctuary habitats include natural resources, as well as cultural resources, ranging from giant humpback whales to rocky reefs to underwater archaeological sites.

The Office of National Marine Sanctuaries is part of the National Oceanic and Atmospheric Administration (NOAA) and has managed these protected areas since 1972 by "work[ing] cooperatively with the public and federal, state, and local officials to promote conservation while allowing compatible commercial and recreational activities."[5] In seeking to fulfill this mission, the Office of National Marine Sanctuaries provides scientific research, monitoring, exploration, educational programs, and outreach to increase public awareness of the importance of national marine sanctuaries.

National marine sanctuaries may be established in a number of ways. The Secretary of Commerce has the authority to designate specific areas of the marine environment as national marine sanctuaries pursuant to provisions of the Marine Protection, Research, and Sanctuaries Act of 1972, now known as the National Marine Sanctuaries Act (NMSA).[6] Congress can pass laws creating marine sanctuaries and the President is authorized under the Antiquities Act to establish Marine National Monuments, which can be managed by

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[2] The White House, Office of the Press Secretary, Memorandum for the Heads of Executive Departments and Agencies, Subject: National Policy for the Oceans, our Coasts, and the Great Lakes, June 12, 2009, *available at* http://www.whitehouse.gov/sites/default/files/page/files/2009ocean_mem_rel.pdf.

[3] THE WHITE HOUSE COUNCIL ON ENVIRONMENTAL QUALITY, FINAL RECOMMENDATIONS OF THE INTERAGENCY OCEAN POLICY TASK FORCE (July 19, 2010), *available at* http://www.whitehouse.gov/files/documents/OPTF_FinalRecs.pdf .

[4] The White House, Office of the Press Secretary, Executive Order, Stewardship of the Ocean, Our Coasts, and the Great Lakes, July 19, 2010, *available at* http://www.whitehouse.gov/the-press-office/executive-order-stewardship-ocean-our-coasts-and-great-lakes.

[5] National Marine Sanctuaries, Frequently Asked Questions, http://sanctuaries.noaa.gov/about/faqs/welcome.html (last visited Aug. 5, 2010).

[6] 16 U.S.C. §§ 1431 - 1445c-1 (2010).

NOAA much like national marine sanctuaries.[7]

The primary purpose of the NMSA is "to identify and designate as national marine sanctuaries areas of the marine environment which are of special national significance and to manage these areas as the National Marine Sanctuary System."[8] Once areas are identified, sanctuary managers should "facilitate to the extent compatible with the primary objective of resource protection, all public and private uses of the resources of these marine areas not prohibited pursuant to other authorities."[9] The NMSA also seeks to "provide authority for comprehensive and coordinated conservation and management of these marine areas"[10] and "enhance public awareness, understanding, appreciation, and wise and sustainable use of the marine environment."[11]

The NMSA provides only the designation process for the sanctuaries and an outline of the required management framework. Once a marine area is designated a sanctuary, management plans and implementing regulations must be developed to provide the necessary resource protection to fulfill the purposes of the NMSA. Other environmental laws, such as the National Environmental Policy Act, the Marine Mammal Protection Act, and the Endangered Species Act, mandate additional decision-making processes and provide additional authority for regulating activities within sanctuaries.

The National Marine Sanctuaries Program (NMSP or Program) is managed by NOAA's Office of National Marine Sanctuaries. The NMSP has a strong community-based focus and works through partnerships and public participation in approaching its mission and finding solutions. Although the Office of National Marine Sanctuaries provides a federal umbrella of national management objectives, each sanctuary is managed by people who live in the area and understand the environment and resources. In addition, the support of the local community is essential for the success of sanctuary programs and management staff solicits input through a variety of mechanisms, including sanctuary advisory councils. The advisory councils, whose membership includes representatives from various user groups, government agencies, and the public at large, provide advice to the sanctuary superintendent on the operation of the sanctuary.[12] Through this local management, the national objectives can be shaped to meet the specific needs of each sanctuary.

In 1992, the U.S. Congress, through amendments to the National Marine Sanctuaries Act, mandated that each sanctuary management plan be reviewed at least once every five years.[13] Effective marine spatial planning is ecosystem-based, integrated, place-based, adaptive, strategic and anticipatory, and participatory.[14] As discussed below, the five-year

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[7] *Id.* § 431.
[8] *Id.* § 1431(b)(1).
[9] *Id.* § 1431(b)(6).
[10] *Id.* § 1431(b)(2).
[11] *Id.* § 1431(b)(4).
[12] National Marine Sanctuaries, Sanctuary Advisory Council Overview, http://sanctuaries.noaa.gov/management/ac/welcome.html (last visited Aug. 5, 2010).
[13] Oceans Act of 1992, Pub. L. No. 102-587, § 2104, 106 Stat 5039, 5041-43 (Nov. 4, 1992).
[14] CHARLES EHLER AND FANNY DOUVERE. MARINE SPATIAL PLANNING: A STEP-BY-STEP APPROACH TOWARD ECOSYSTEM-BASED MANAGEMENT. INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION AND MAN AND THE BIOSPHERE PROGRAMME, IOC Manual and Guides No. 53, ICAM Dossier No. 6, 18 (2009).

reviews, in combination with ongoing sanctuary planning processes, facilitate an adaptive approach to management that incorporates all the elements of effective marine spatial planning. Furthermore, the management frameworks of the national marine sanctuaries are likely to form an important part of the foundation upon which the new regional coastal and marine spatial plans mandated by the National Ocean Policy are built.[15]

II. Adaptive Management in National Marine Sanctuaries

Although management plans are developed during the designation process, these are not intended to be static documents. As mentioned above, each plan must be reviewed every five years. During this management plan review, the National Marine Sanctuary Program must "evaluate the substantive progress toward implementing the management plan and goals … [and] revise the management plan and regulations as necessary to fulfill the purposes and policies of [the NMSA.]"[16] An essential element of the management plan review is an evaluation of "the effectiveness of site-specific management techniques and strategies."[17] The five-year review process, along with other routine sanctuary evaluation efforts, "foster a feedback loop that encourages an internal approach to problem solving and improved performance."[18] As such, the National Marine Sanctuary Program is one of the few federal agencies with a Congressional authorization to undertake an adaptive approach to management. By continually reviewing the management plans for each sanctuary and the scientific research conducted on the sanctuaries and sanctuary resources and adapting the management techniques and regulations to address identified changes and emerging concerns, the National Marine Sanctuary Program is able to flexibly manage the ocean areas under their care.

The National Marine Sanctuary Program's adaptive approach to management is based on four basic principles. First, a precautionary approach is utilized. Lack of information on a particular sanctuary resource or impacts to that resource is no excuse for sanctuary managers to neglect it. Constant protection must be provided to all sanctuary resources and management measures should be regularly updated. Second, the Program strives for proactive decision-making. While it is not always possible to be proactive, resolving an issue before it becomes a larger problem is the Program's ultimate goal. Third, the Program has an extremely firm commitment to participatory public processes. This is most visible in the Sanctuary Advisory Councils, which consist of over 400 members across the country, who provide day-to-day input on various issues. Fourth, the Program strives to ensure use of the best available science for its research. Disagreements are common, of course, on exactly what constitutes the "best available" science, but the objective remains.

The Program uses several management mechanisms to apply these adaptive management principles and achieve its management goals. The first management mechanism is the process of designating a marine area as a national marine sanctuary. This process involves forming the boundaries of the sanctuary, making regulations specific to the sanctuary, and looking at, and learning from, past designations. The review and revision of management

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[15] OPTF Final Recommendations, *supra* note 3, at 56.
[16] 16 U.S.C. § 1434(e).
[17] *Id.*
[18] National Marine Sanctuaries, Sanctuary Management 101, http://sanctuaries.noaa.gov/management/mgt101.html (last visited Aug. 6, 2010).

plans are other management mechanisms that enable adaptive decision-making. Management plans establish the basic management framework for the individual sanctuary. They contain research priorities, outreach and educational goals, and means of protection for the resources specific to each sanctuary. Finally, sanctuary regulations establish enforceable restrictions that are unique to each sanctuary and the regulations can be amended if management changes are necessary.

Other important decision-making processes include decisions on the allocation of funds appropriated by Congress for the management of the National Marine Sanctuaries, the issuance of permits for use of a specific sanctuary or resource, and the enforcement of permit conditions. The National Marine Sanctuaries Program also undertakes numerous educational programs to inform the community, sanctuary stakeholders, and the nation about national marine sanctuaries and their significance. By taking full advantage of these decision-making processes, the Program is able to be firm in enforcing its regulations and standards while still being flexible to respond to changing conditions and circumstances.

Another facet of adaptive management of the sanctuaries is obtaining feedback from various sources on how well the Program is using the management mechanisms outlined above and accomplishing management objectives. The feedback comes from internal sources, such as the management plan reviews and routine sanctuary condition reports which are produced in advance of management plan reviews. Condition reports provide a summary of resources in each sanctuary, the pressures on those resources, the current condition and trends, and management responses to the pressures that threaten the integrity of the marine environment. The condition reports lay the groundwork for any changes that need to be made in the management plans during the five-year reviews. Another important source of internal feedback is the interaction of different branches of the Program. The scientific, policy, and legal staffs in Washington, D.C. and the individual sanctuaries develop programs together and share lessons-learned to improve adaptive management at the sanctuaries.

Feedback also comes from external sources. The primary external source is each sanctuary's Sanctuary Advisory Council. As discussed above, these councils consist of local citizens who volunteer their time to attend meetings every other month to provide input on the status of the local sanctuary and its management. Council members offer a unique view from a local perspective. Other external sources of feedback are evaluations performed by the Department of Commerce's Office of the Inspector General and the National Academy of Public Administration, who review the Program and share opinions on how the Program is performing and whether it is achieving its management goals.[19] So far, all these evaluations have been positive, but there is always room for improvement.

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[19] *See, e.g.*, U.S. DEPARTMENT OF COMMERCE, OFFICE OF THE INSPECTOR GENERAL, NATIONAL MARINE SANCTUARY PROGRAM PROTECTS CERTAIN RESOURCES, BUT FURTHER ACTIONS COULD INCREASE PROTECTION, FINAL INSPECTION REPORT, No. IPE-18591 (Feb. 2008), *available at* http://www.oig.doc.gov/oig/reports/2008/IPE-18591.pdf; NATIONAL ACADEMY OF PUBLIC ADMINISTRATION, READY TO PERFORM: PLANNING AND MANAGEMENT AT THE NATIONAL MARINE SANCTUARY PROGRAM (Oct. 2006), *available at* http://sanctuaries.noaa.gov/news/pdfs/napareport.pdf.

III. Case Studies

Adaptation can occur at anytime within a sanctuary. Education programs can be redesigned to address an emerging user conflict. Sanctuary regulations can be amended to prohibited activities recently identified as harmful to sanctuary resources. Research can be commissioned to answer questions as to the impact of user activities or changing environmental conditions and inform future management decisions. Adaptation can also occur during the initial designation process, as highlighted by the first case study on the Florida Keys National Marine Sanctuary. A second case study on a joint management plan review for three California sanctuaries illustrates the adaptive nature of the five-year reviews.

A. Florida Keys National Marine Sanctuary

The Florida Keys National Marine Sanctuary (FKNMS) is an example of sanctuary designation that utilized an adaptive approach. In 1990, Congress established the FKNMS through the Florida Keys National Marine Sanctuary and Protection Act.[20] The FKNMS covers 2,800 square nautical miles surrounding the Florida Keys, including the productive waters of Florida Bay, the Gulf of Mexico, and the Atlantic Ocean.[21] The Act established as national policy the protection and preservation of the "living and other resources of the Florida Keys marine environment."[22]

The cornerstone of the Sanctuary's adaptive management approach is its "Zoning Action Plan."[23] FKNMS contains 24 fully protected (no-take) marine zones, which are managed according to the needs of each zone. The designated zones allow managers to apply more restrictive measures to critical areas and allow more expansive private and public use in other areas. According to the FKNMS website, "marine zoning allows the sanctuary to focus the majority of its management efforts on a small portion of the sanctuary while addressing water quality and habitat degradation in the broader unzoned portions of the area."[24]

> Zoning is critical to achieving the Sanctuary's primary goal of resource protection. Its purpose is to protect and preserve sensitive components of the ecosystem by regulating within the zoned areas, while facilitating activities compatible with resource protection. Zoning will ensure that areas of high ecological importance will evolve in a natural state, with minimal human influence. Zoning will also promote sustainable use of the Sanctuary resources, and will protect areas representing diverse Sanctuary habitats and areas important for maintaining natural resources (e.g., fishes, invertebrates, etc.) and ecosystem functions. [25]

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[20] Pub. L. No. 101-605, 104 Stat. 3089 (Nov. 16, 1990) (codified in 16 U.S.C. § 1433).
[21] Florida Keys National Marine Sanctuary: Visitor Information, http://floridakeys.noaa.gov/visitor_information/welcome.html (last visited Aug. 6, 2010).
[22] Florida Keys National Marine Sanctuary and Protection Act, *supra* note 20, § 3(a).
[23] NOAA, FLORIDA KEYS NATIONAL MARINE SANCTUARY: FINAL MANAGEMENT PLAN/ENVIRONMENTAL IMPACT STATEMENT, Vol. II, at 257 (1996) *available at* http://floridakeys.noaa.gov/regs/fmp1.pdf . [hereinafter *FKNMS Final Management Plan*].
[24] Florida Keys National Marine Sanctuary, The Zoning Action Plan, http://floridakeys.noaa.gov/regs/zoning.html (last visited Aug. 6, 2010).
[25] FKNMS Final Management Plan, *supra* note 23, at 257.

The Research and Monitoring Action Plan for FKNMS establishes that research and monitoring will be conducted within areas zoned as Sanctuary Preservation Areas and Ecological Reserves to provide information for better management.[26] The Plan calls for coordination between the Sanctuary and the EPA and the Florida Department of Environmental Protection Water Quality Monitoring Program "to maximize the use of limited resources."[27] Many different groups participate in monitoring, including local, state, and federal agencies, public and private universities, environmental organizations, and trained volunteers.[28]

In addition to the monitoring efforts, scientific reports, such as the *2002-03 Florida Keys National Marine Sanctuary Science Report* (updated in 2006), provide information on the effectiveness of the zoning plan. Managers use this information to adjust management techniques for specific zones. In 2003, the Pew Oceans Commission concluded that marine zoning had substantially improved management of the Florida Keys coral reef ecosystem.[29]

B. Cordell Bank, Gulf of the Farallones, and Monterey Bay JMPR

In November 2001, NOAA issued a "Notice of Initiation of Joint Review of Management Plans/Regulations (JMPR) for the Cordell Bank, Gulf of the Farallones, and Monterey Bay National Marine Sanctuaries."[30] Because the three sanctuaries, located along the northern and central California coast, are adjacent to one another and share many of the same resources and issues, a joint review was seen as more cost-effective and efficient than conducting individual reviews. Seven years of study, planning, and extensive public comment later, NOAA announced the release of the final revised management plans, regulations, and a joint final environmental impact statement for the three sanctuaries.[31]

While the final plans consist primarily of non-regulatory actions to expand research, education, outreach, and enforcement programs, the JMPR did result in some significant regulatory changes to strengthen protections to sanctuary resources.[32] The management decisions with respect to two sanctuary resources, Davidson Seamount and white sharks, are illustrative of how the NMSP was able to respond to emerging issues during the JMPR.

1. Davidson Seamount

Davidson Seamount, the remnant of an ancient volcano, is located 120 kilometers to the

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[26] *Id.* at 150-51.
[27] *Id.* at 151.
[28] U.S. DEPARTMENT OF COMMERCE, NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL MARINE SANCTUARY PROGRAM, 2002-03 FLORIDA KEYS NATIONAL MARINE SANCTUARY SCIENCE REPORT: AN ECOSYSTEM REPORT CARD AFTER FIVE YEARS OF MARINE ZONING, Marine Sanctuaries Conservation Series NMSP-06-12, 19 (Brian D. Keller & S. Donahue eds., 2006).
[29] PEW OCEANS COMM'N, AMERICA'S LIVING OCEANS: CHARTING A COURSE FOR SEA CHANGE: A REPORT TO THE NATION 49 (2003).
[30] 66 Fed. Reg. 56540-41 (Nov. 8, 2001).
[31] National Oceanic and Atmospheric Administration, Press Release, NOAA Release Plans for Managing and Protecting Cordell Bank, Gulf of the Farallones, and Monterey Bay National Marine Sanctuaries, Nov. 20, 2008.
[32] *Id.*

southwest of Monterey and is one of the largest known seamounts along the western coast of the United States.[33] Although Davidson Seamount is 2,400 meters tall, it remains 1,250 meters below the surface.[34] The Davidson Seamount is populated by a diversity of deep-sea corals and has been called "An Oasis in the Deep" due to its large coral forests, vast sponge fields, crabs, deep-sea fishes, shrimp, basket stars, and high numbers of rare and unidentified benthic species.[35]

Although the original boundaries of the sanctuary established upon its designation in 1992 did not include Davidson Seamount, NOAA had been concerned with protecting Davidson Seamount and its resources for some time. Many of the Davidson Seamount coral species are large and fragile to physical disturbance.[36] After Sanctuary scientists captured stunning images of the biological communities living in and around Davidson Seamount during an expedition in 2002,[37] the Monterey Bay National Marine Sanctuary (MBNMS) Advisory Council unanimously voted in August 2003 that Davidson Seamount meets Sanctuary designation standards.[38] During the JMPR, managers identified a number of existing and potential threats to Davidson Seamount including "bio-prospecting, cumulative impacts from research collecting of long-lived species, new or unknown forms of seafloor disturbance, new technologies to harvest from the seabed, 'exploratory' benthic fishing which could destroy habitat and long-lived species, and marine debris/dumping."[39]

In response to the scientific information generated during the 2002 expedition and a follow-up expedition in 2006[40] and input from MBNMS Sanctuary Advisory Council, NOAA's revised management plan proposed expanding the Monterey Bay National Marine Sanctuary to include the Davidson Seamount Management Zone, 585 square nautical miles of ocean waters and the submerged lands underneath centered on the summit of Davidson Seamount.[41] "By incorporating the seamount into the MBNMS, its resources will be protected and opportunities will be provided for a better understanding of the seamount."[42] Given the serious impact bottom trawling might have in the area, NOAA also issued regulations which prohibited fishing within the DSMZ below 3,000 feet.[43]

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[33] Andrew P. DeVogelaere et al, *Deep-sea Corals and Resource Protection at the Davidson Seamount, California*, U.S.A., 1190 *in* COLD-WATER CORALS AND ECOSYSTEMS (A. Freiwald & J.M. Roberts eds., 2005).

[34] *Id.*

[35] Monterey Bay National Marine Sanctuary, Davidson Seamount, http://montereybay.noaa.gov/research/dsmz/welcome.html (last visited Aug. 6, 2010).

[36] DeVogelaere, *supra* note 33, at 1196.

[37] For more information on the 2002 Davidson Seamount Expedition, *see* NOAA Ocean Explorer, Davidson Seamount, http://oceanexplorer.noaa.gov/explorations/02davidson/welcome.html.

[38] DeVogelaere, *supra* note 33, at 1196.

[39] NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL OCEAN SERVICE, NATIONAL MARINE SANCTUARY PROGRAM, MONTEREY BAY NATIONAL MARINE SANCTUARY FINAL MANAGEMENT PLAN 134-35 (Oct. 2008), *available at* http://sanctuaries.noaa.gov/jointplan/fmp/101408mbnmsfmp.pdf [hereinafter *MBNMS Final Management Plan*].

[40] NOAA Ocean Explorer, Davisdon Seamount: Exploring Ancient Coral Gardens, http://oceanexplorer.noaa.gov/explorations/06davidson/welcome.html (last visited Aug. 6, 2010).

[41] MBNMS Final Management Plan, *supra* note 39, at 135.

[42] *Id.*

[43] *Id.* at 112.

2. White Sharks

Gulf of Farallones National Marine Sanctuary (GFNMS) has one of the largest seasonal concentrations of white sharks (*Carcharodon carcharias*) in the world.[44] In 2001, the Point Reyes Bird Observatory (PRBO) Conservation Science, a San Francisco-based non-profit organization, submitted a petition to the GFNMS expressing concern over activities by for-profit enterprises attempting to show white sharks to paying customers in the GFNMS and requesting emergency regulations to protect white sharks from these commercial activities.[45] While white sharks are protected from harassment by provisions of the Endangered Species Act, at the time of the JMPR there were no Sanctuary-specific protections for white sharks. GFNMS regulations addressed wildlife disturbance through prohibitions against disturbing seabirds or marine mammals by flying motorized aircraft at low altitudes and discharging or depositing matter into Sanctuary waters.[46]

During the JMPR, NOAA's Office of National Marine Sanctuaries found that "Disturbance related to human interaction is increasing as a result of controversial cage shark diving operations, also known as adventure tourism, and other wildlife watching operations. These activities may degrade the natural environment, impacting the species as a whole, and individual sharks may be negatively impacted from repeated encounters with humans and boats."[47] To resolve user conflicts between shark researchers and adventure tourism and prevent interference with the seasonal feeding behavior of white sharks, the final revised management plan and implementing regulations for the GFNMS prohibit white shark attraction. Attraction "means the conduct of any activity that lures or may lure any animal in the Sanctuary by using food, bait, chum, dyes, decoys (e.g., surfboards or body boards used as decoys), acoustics or any other means, except the mere presence of human beings (e.g., swimmers, divers, boaters, kayakers, surfers)."[48] The new regulations also prohibit approaching within 50 meters of a white shark within 2 nautical miles around the Farallon Islands. In addition, the GFNMS initiated the White Shark Stewardship Project that includes: (1) public and boater outreach, (2) naturalist training, (3) school education programs, (4) permitting, (5) monitoring, and (6) coordinating with the NOAA Office of Law Enforcement.[49] These efforts, in combination with the new regulations, will "greatly increase the protection of the white sharks known to make an annual migration to the Farallon Islands to feed and would prevent disturbances and/or alterations in their natural

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[44] U.S. Dept. of Commerce, National Oceanic and Atmospheric Adminstration, Final Rule, Gulf of the Farallones National Marine Sanctuary Regulations; Monterey Bay National Marine Sanctuary Regulations; and Cordell Bank National Marine Sanctuary Regulations, 73 Fed. Reg. 70488, 70490 (Nov. 20, 2008), *available at* http://sanctuaries.noaa.gov/jointplan/fmp/112008final_rule.pdf [hereinafter *Final Rule*].

[45] PRBO Conservation Science, Regulations Protecting White Sharks, http://www.prbo.org/cms/index.php?mid=173#petition (last visited Aug. 6, 2010).

[46] NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL OCEAN SERVICE, NATIONAL MARINE SANCTUARY PROGRAM, CORDELL BANK, GULF OF FARALLONES, AND MONTEREY BAY NATIONAL MARINE SANCTUARIES FINAL ENVIRONMENTAL IMPACT STATEMENT, 2-15 (Sept. 2008), *available at* http://sanctuaries.noaa.gov/jointplan/feis/091608feis_jmpr.pdf [hereinafter *Final EIS*].

[47] Final Rule, *supra* note 44, at 70499.

[48] *Id.*

[49] Gulf of Farallones National Marine Sanctuary, White Shark Stewardship Program, http://farallones.noaa.gov/eco/sharks/sharks.html (last visited Aug. 6, 2010).

behaviors, including feeding, breeding, aggregating, and migrating."[50]

IV. Conclusion

As illustrated by the above case studies, the National Marine Sanctuaries Program does have the flexibility to respond to changing circumstances at the individual sanctuaries. However, while it is an adaptive approach to management, it is not "pure" adaptive management. For instance, constituent expectations require that certain aspects of management, such as regulations, be more permanent than others. In general, people expect regulations to stay the same and businesses often make important strategic decisions based on that assumption. This expectation of permanence, however, is not in line with the ideals of adaptive management, which are flexibility and continual improvements and revisions. Limited resources, including funds, people, and capabilities, also make it difficult to successfully implement every management mechanism in every situation.

The National Marine Sanctuary Program is always looking for ways to improve, however. Recently the Program has been working to improve the process for making changes and improvements after feedback is obtained through public participation or management reviews and needed changes are identified. Whether in the form of revising a regulation or providing some new form of protection for a resource, the revisions need to be made quickly and efficiently. This is a challenging area for any federal agency. In addition, there is always room for improvement with respect to the amount of scientific feedback the Program receives. There is always a need for more research and data, and the Program continually seeks opportunities to collaborate with other federal agencies in gathering available data. The Program is also striving to focus more on outcomes rather than output. For example, instead of focusing on how many educational programs are offered in the sanctuaries, the Program is trying to focus on how many people are reached with each education program and how many minds are being enlightened about the importance of sanctuaries.

Strong legislative mandates and an adaptive approach to management enable sanctuary managers to address a range of threats to the sanctuaries including overfishing, pollution, habitat loss, and invasive species. Climate change, however, poses a monumental challenge to sanctuary managers. The effects of climate change, such as ocean acidification, sea level rise, and increasing global sea surface temperatures, have the potential to fundamentally alter the coastal and marine ecosystems. Fortunately, the National Marine Sanctuary Program has the tools available to understand these global changes and their effects at the local level and it is already working to develop tailored strategies to manage impacts to sanctuary habitats and marine life.[51]

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[50] Final EIS, *supra* note 46, at 3-58.

[51] *Rising to the Challenge: Managing Climate Impacts in the Sanctuaries*, SANCTUARY WATCH 6 (Spring 2009), *available at* http://sanctuaries.noaa.gov/news/pdfs/sanctuarywatch/sw0609.pdf .

Challenges in Adaptive Management: Chemosynthetic Communities in the Gulf of Mexico

Gregory S. Boland[1]

Abstract: Gregory Boland examines the challenges in adaptive management through the lens of the Offshore Minerals Management Program. He describes environmental laws affecting the program and discusses how an adaptive approach to management is possible within that framework. Boland describes how an adaptive management process was used by the Minerals Management Service (recently reorganized as the Bureau of Ocean Energy Management, Regulation and Enforcement) to provide a consistent and comprehensive approach to protect high-density chemosynthetic communities of the Gulf of Mexico.

I. Introduction

This paper describes adaptive management practices applied by a bureau of the Department of Interior, the Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE), for the protection of a recently discovered and unique type of deep sea community known generally as chemosynthetic communities. The role of BOEMRE in managing offshore U.S. energy and mineral development and authorizing legislation is addressed in opening segments, followed by some brief background on deep sea communities, and an overview of chemosynthetic communities in the Gulf of Mexico (GOM). Management of the subject biological communities has presented numerous challenges inherent in adaptive management due to the extreme environment in which they occur and their initially unknown basic biology.

The BOEMRE, a bureau of the Department of the Interior with about 1,700 people in 20 cities across the United States, has two primary programs: Minerals Revenue Management, and Offshore Energy and Minerals Management.[2] The BOEMRE manages energy development in over 1.76 billion offshore acres of federal land called the Outer Continental

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[2] A reorganization of this program structure was announced at the time of writing.

Shelf (OCS)[3] and annually disburses more than $8 billion in minerals revenue. Major regulating policy primarily originates from the Outer Continental Shelf Lands Act.[4] Other regulatory sources include the National Environmental Policy Act (NEPA) and numerous other laws such as the Marine Mammal Protection Act, Clean Air Act, Coastal Zone Management Act, and the Magnuson-Stevens Fishery Management Act. With passage of the Energy Policy Act of 2005,[5] the Minerals Management Service (MMS) was named lead authority for renewable energy projects, such as wave, wind, and current energy, on federal offshore lands. The BOEMRE also extensively funds environmental studies to obtain information necessary for NEPA analysis and decision-making by management. Since it was founded in 1982, the MMS has funded over $800 million in environmental studies. MMS is now BOEMRE.

II. Chemosynthetic Communities in the Gulf of Mexico

Deep sea exploration and study are very difficult, not unlike space exploration. The northern GOM is a geologically complex basin with a maximum depth of 3800 m (12,464 ft). It has been described as the most complex continental slope region in the world. Regional topography of the slope consists of basins, knolls, ridges, and mounds derived from the dynamic adjustments of salt to the introduction of large volumes of sediment over long time scales. This complex structure has resulted in widespread seabed structural faulting and the migration of hydrocarbons that become the key factor for the presence of significant biological communities in the deep GOM.

A. Gulf of Mexico Deep Sea Biological Communities

More than 99% of the sea floor in the GOM consists of soft sediment made up of various mixtures of primarily silt and clay. These wide-spread soft bottom communities are well described in the final reports from two major MMS studies, the Northern Gulf of Mexico Continental Slope Study (1988)[6] and the Northern Gulf of Mexico Continental Slope Habitats and Benthic Ecology Study (2009).[7] There are two other major habitat types considered significant in the GOM. These are deep-water or cold-water coral habitats and chemosynthetic communities. Although known for a longer period, cold-water coral communities have only recently been investigated in the GOM and are not a major part of

[3] The term "Outer Continental Shelf" is a legal term created by federal law and is distinct from the geographic term "continental shelf." There is no scientific definition of the OCS. Legally, the OCS comprises that part of the submerged lands, subsoil, and seabed, lying between the seaward extent of the states' jurisdiction and the seaward extent of federal jurisdiction (generally 200 nautical miles offshore).

[4] Outer Continental Shelf Lands Act, 43 U.S.C. §§ 1331 – 1356a (2005).

[5] Energy Policy Act of 2005, Pub. L. No. 109–58, 119 Stat. 594 (Aug. 8, 2005), *available at* http://www.epa.gov/oust/fedlaws/publ_109-058.pdf.

[6] MINERAL MANAGEMENT SERVICE, NORTHERN GULF OF MEXICO CONTINENTAL SLOPE STUDY, FINAL REPORT: YEAR 4, VOLUME II: SYNTHESIS REPORT, OCS Study/MMS 88-0053 (Benny J. Gallaway ed., 1988), *available at* http://www.gomr.mms.gov/PI/PDFImages/ESPIS/3/3696.pdf [hereinafter *Gallaway*].

[7] MINERAL MANAGEMENT SERVICE, NORTHERN GULF OF MEXICO CONTINENTAL SLOPE HABITATS AND BENTHIC ECOLOGY STUDY: FINAL REPORT, OCS Study/MMS 2009-039 (Gilbert T. Rowe & Mahlon C. Kennicutt II eds., 2009), *available at* http://www.gomr.mms.gov/PI/PDFImages/ESPIS/4/4842.pdf [hereinafter *Rowe & Kennicutt*].

this discussion.[8] Ironically, these important deep coral communities in the GOM rely on the hard substrate created by the principal subject, chemosynthetic communities.

B. Gulf of Mexico Chemosynthetic Communities

Chemosynthetic communities are groups of animals living in the deep sea (deeper than 300 m (984 ft)) that live on dissolved gases through a symbiotic association with bacteria living inside their tissues. They are remarkable because these are the only large animals that utilize a food source independent of the photosynthesis that supports all other life on earth. There are four general community types in the GOM. These are: (1) communities dominated by tube worms (Figure 1), (2) mussels (Figure 2), (3) clams living on the sediment surface, and (4) a different group of clams that live within the sediments of the seabed. Bacterial mats are present at all sites visited to date. These faunal groups tend to display distinctive characteristics in terms of how they aggregate, the size of aggregations, the chemical properties of the habitats in which they occur and, to some degree, the other non-chemosynthetic fauna that occur with them. The necessary conditions for their growth exist only in relatively small, widely scattered habitats. Many of the species found at these cold seep communities in the Gulf are new to science and remain undescribed.

Fig. 1. The gill plume of a chemosynthetic tube worm. These animals still need oxygen for respiration, but have no digestive tract. Symbiotic bacteria living in their tubes obtain sulfides from the sediment bottom and provide energy to the tube worm. They can live up to 450 years. The green band was stained in previous years to measure growth rate. Image courtesy of MMS and NOAA OER, Expedition to the Deep Slope.

Fig. 2. Chemosynthetic mussel community (different species can live off methane, hydrogen sulfide or both) and associated sea cucumbers at a depth of 2,200 m (7,218 ft). Image courtesy of MMS and NOAA OER, Expedition to the Deep Slope.

[8] For more information on these coral communities, *see* CSA INTERNATIONAL, INC., CHARACTERIZATION OF NORTHERN GULF OF MEXICO DEEPWATER HARD BOTTOM COMMUNITIES WITH EMPHASIS ON *LOPHELIA* CORAL, OCS Study/MMS 2007-044 (2007), *available at* http://www.gomr.mms.gov/PI/PDFImages/ESPIS/4/4264.pdf [hereinafter *CSA International 2007*]; W.W. SCHROEDER, SEAFLOOR CHARACTERISTICS AND DISTRIBUTION PATTERNS OF *LOPHELIA PERTUSA* AND OTHER SESSILE MEGAFAUNA AT TWO UPPER-SLOPE SITES IN NORTHEASTERN GULF OF MEXICO, OCS Study/MMS 007-035 (2007), *available at* http://www.gomr.mms.gov/PI/PDFImages/ESPIS/4/4256.pdf.

C. Discovery

This new type of large invertebrate, one that derives its food source from chemosynthesis, was not discovered anywhere on earth until 1977. The first discovery was made unexpectedly at hydrothermal vents in the eastern Pacific Ocean during geological explorations of a mid-Atlantic spreading center.[9] Two scientists, John B. Corliss and Jerry van Andel first witnessed dense chemosynthetic tube worms from the submersible *Alvin* on February 17, 1977.[10] This expedition followed the unanticipated discovery of large clams associated with the Galapagos Rift hydrothermal vents using a remote camera sled the previous year.[11] Similar communities were first discovered in the Eastern Gulf of Mexico in 1983 on another *Alvin* submersible dive. This expedition was investigating the bottom of the Florida Escarpment in areas of "cold" brine seepage where they unexpectedly discovered tube worms and mussels.[12]

Two groups discovered chemosynthetic communities in the Central GOM essentially concurrently in November 1984. During investigations by Texas A&M University to determine the effects of oil seepage on benthic ecology (until this investigation, all effects of oil seepage were assumed to be detrimental), bottom trawls unexpectedly recovered extensive collections of chemosynthetic organisms including tube worms and clams.[13] Just prior to this, LGL Ecological Research Associates[14] was conducting a research cruise as part of the multiyear MMS Northern GOM Continental Slope Study.[15] Bottom photography (processed on board the vessel) resulted in clear images of vesicomyid clam communities later realized to be chemosynthetic-based (Figure 3), coincidentally in the same manner as the first discovery of clam communities by camera sled in the Pacific in 1976.[16] The first images of tube worm communities *in situ* in the Northern GOM were obtained during this same LGL/MMS 1984 cruise[17] (Figure 4), which occurred prior to the initial submersible

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[9] J.B. Corliss et al., *Submarine Thermal Springs on the Galapagos Rift*, 203 SCIENCE 1073-1083 (1979).

[10] Woods Hole Oceanographic Institute, Alvin Dive Information, Dive Number 713, http://www.marine.whoi.edu/divelog.nsf/7d6ced7cbf2c43a285256812005446a6/fee12bd002bd79908525620b006c94b0?OpenDocument (last visited June 16, 2010).

[11] The first photographs of new chemosynthetic life forms were taken remotely in 1976 by Dr. Peter Lonsdale from Scripps aboard the Scripps vessel R/V *Melville* using DeepTow, a towed camera platform.

[12] C.K. Paull et al., *Biological Communities at the Florida Escarpment Resemble Hydrothermal Vent Taxa*, 226 SCIENCE 965-967 (1984).

[13] Mahlon C. Kennicutt et al., *Vent-type Taxa in a Hydrocarbon Seep Region on the Louisiana Slope*, 317 NATURE 351-353 (1985).

[14] LGL Ecological Research Associates, Inc. is an independently owned environmental service company located in Bryan, Texas. LGL, Corporate Resume and Recent Experience, http://www.lgltex.com/corp_experience.htm (last visited June 16, 2010).

[15] *See* Gallaway, *supra* note 6.

[16] An analysis of these images was published in 1987. *See*, I. Rosman, G.S. Boland, and J.S. Baker, *Aggregations of* Vesicomyidae *on the Continental Slope off Louisiana*, 34 DEEP SEA RESEARCH PART A. OCEANOGRAPHIC RESEARCH PAPERS 1811-1820 (1987).

[17] These images were not processed until after the cruise. *See*, G.S. Boland, *Discovery of Co-occurring Bivalve* Acesta *sp. and Chemosynthetic Tube Worms Lamellibrachia*, 323 NATURE 759 (1986).

investigations and firsthand descriptions of Bush Hill, the name given to the first chemosynthetic community discovered in the GOM, in 1986.

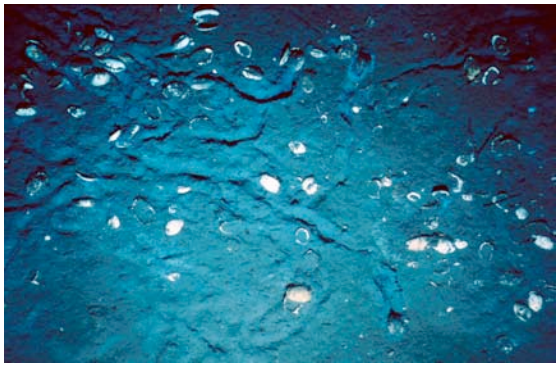

Fig. 3. The first evidence of a chemosynthetic community in northern Gulf of Mexico; image taken November 14, 1984, depth 950 m (3,116 ft). Note living clams plowing through sediment exposing their tissues to sulfides that support their symbiotic chemosynthetic bacteria. Image courtesy Gregory S. Boland/LGL Ecological Research Associates.

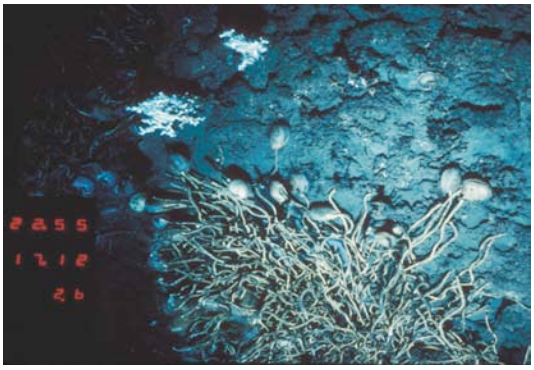

Fig. 4. This is the first image of a chemosynthetic tube worm community in the northern GOM taken November 12, 1984. Also present are two "cold-water" coral colonies (*Lophelia pertusa*), hagfish among the tube worms, and an unusual commensal relationship between the tube worms and numerous bivalves attached only to the ends of the living tube worms. Image courtesy Gregory S. Boland/LGL Ecological Research Associates.

III. Challenges of Adaptive Management

Beginning in 1985, there was recognition of a completely new kind of life form living in the deep GOM, not just at the bottom of the Florida Escarpment, but also distributed throughout an extensive area of the northern GOM slope in one of the richest oil and gas regions of the world. Exploration and development of these energy sources was also beginning to enter deeper and deeper water depths. It was the responsibility of MMS to investigate these new and unique communities to enable informed decisions for the management of the oil and gas industry and related potential impacting activities.

The use of the term adaptive management in this paper does not imply a strict application of the process. Not all the criteria for a classic adaptive management regime, such as the use of models to evaluate management decisions, are met. Rather, this is an adaptive approach where new information and learning is occurring and that knowledge is being used to revise management decisions on an ongoing basis.

A. The First Step

An appropriate first step was to take a close look at these new chemosynthetic communities. To do that, a submersible or camera system is required to descend to at least 500 m (1,640 ft) underwater. At the time, there were limited facilities that could accomplish

this. Only three research submersibles were available (the *Alvin* from Woods Hole Oceanographic Institution and the two *Johnson Sea Link* submersibles (Figure 5) at the Harbor Branch Oceanographic Institution) and a limited number of remotely operated vehicles (ROVs) were available for research purposes.

Fig. 5. One of the two *Johnson Sea Link* submersibles operated by the Harbor Branch Oceanographic Institution. Forward acrylic sphere holds one pilot and principal science observer, aft metal sphere holds a sub crew member and one additional science observer. Maximum diving depth 1,000 m (3,280 ft). Image courtesy of Gregory S. Boland.

The first manned mission to observe chemosynthetic communities in the Northern GOM was initiated through a contract modification and extension of an ongoing study funded by MMS studying the soft bottom habitats of most of the entire northern GOM continental slope. This study, the *Northern Gulf of Mexico Continental Slope Study*[18] was modified to extend its contract period to include this new mission using the *Johnson Sea Link* submersible to study these new habitats. From a brief seven-day mission in September 1986 on the vessel R/V *Edwin Link,* one of the most extensive chemosynthetic communities in the GOM was discovered on the first dive at a depth of 543 m (1,781 ft). It was nicknamed "Bush Hill" due to abundant tube worm colonies or "bushes" observed as the submersible cruised over it for the first time.[19]

A good deal of understanding was obtained from this first submersible mission with regard to the correlation between these habitats and geophysical characteristics, *i.e.*, seabed faulting, gas and oil seeps, and gassy sediments. This knowledge was critical for developing a mechanism to predict the location of these communities using some kind of remote sensing as opposed to being required to visually look at every square foot of the seabed to demonstrate the presence or absence of these newly discovered communities.

[18] Gallaway, *supra* note 6.

[19] Author was the first submersible dive sphere observer.

B. Initial Protection

Immediately after discovery of chemosynthetic communities, MMS recognized their significance and created initial protective measures designed to prevent direct impact on these habitats by the placement of offshore structures on the seabed. An avoidance policy was implemented early on, but the first written regulatory policy was not completed until 1988. The instrument used is termed a Notice to Lessees or NTL. The NTLs supplement regulations that govern operations on the OCS and provide clarification or interpretation of regulations and further guidance to lessees and operators in the conduct of their operations. These guidance documents can be implemented much more efficiently than MMS's overarching regulations broadly regulating offshore operations.[20] The first Notice to Lessees, entitled NTL 88-11: *Implementation of Measures to Detect and Protect Deepwater Chemosynthetic Communities*, required mandatory identification and avoidance of chemosynthetic communities and avoidance of damage from anchors and platform structure components.

C. Understanding

After the first MMS-funded exploration expedition in 1986, a door was opened, but as with any major new discovery, it was obvious there was still very little known about these incredible communities spread across the northern Gulf. The MMS initiated the first of three major studies dedicated to the study of Gulf chemosynthetic communities beginning in 1991. With some additional support from the National Oceanic and Atmospheric Administration (NOAA), two major field sampling cruises were launched in 1991 and 1992 by Texas A&M University, the MMS-funded contractor. A total of 6 sites of the approximately 43 known locations at the time were intensively studied, again using the *Johnson Sea Link* submersibles from Harbor Branch Oceanographic Institution. This four-year effort, later to be known as Chemo I, resulted in the keystone publication final report, *Chemosynthetic Ecosystems Study*.[21]

This large multidisciplinary Chemo I study was just the beginning of the learning process. A more comprehensive study was necessary to begin to understand the ecosystem-based processes that regulated both the distribution and health of these chemosynthetic communities, and to begin to approach an understanding of their natural stability and how they change over time.

A second major study, *Stability and Change in Gulf of Mexico Chemosynthetic Communities*, which came to be known as Chemo II, was funded by MMS in 1996.[22] The

[20] These regulations can be found in the Code of Federal Regulations Title 30, Mineral Resources, and Title 40, Protection of the Environment.

[21] MINERAL MANAGEMENT SERVICE, CHEMOSYNTHETIC ECOSYSTEMS STUDY FINAL REPORT, OCS Study/MMS 95-0023 (I. R. MacDonald, W. W. Schroeder, & J. M. Brooks eds., 1995) *available at* http://www.gomr.mms.gov/PI/PDFImages/ESPIS/3/3323.pdf [hereinafter *Chemo I*].

[22] MINERAL MANAGEMENT SERVICE, STABILITY AND CHANGE IN GULF OF MEXICO CHEMOSYNTHETIC COMMUNITIES, VOLUME II: TECHNICAL REPORT, OCS Study MMS 2002-036 (I. R. MacDonald ed., 2002), *available at* http://www.gomr.mms.gov/PI/PDFImages/ESPIS/3/3072.pdf [hereinafter *Chemo II*].

MMS contract required that the researchers take an integrated, multi-disciplinary approach to address the complex issues associated with the protection of these biological assemblages. This study encompassed ecological studies at both regional and local scales, as well as an evaluation of temporal changes in these communities. An understanding of the stability and change within these communities was addressed in the context of their interactions within the geological, chemical, and oceanographic setting. Knowledge of the processes that control the distribution, health, and succession of communities in these environments is necessary to forecast potential impacts. Integrated studies were designed to collect ecological, geological, chemical, and oceanographic information related to the longevity, robustness, and recovery of chemosynthetic communities.

D. Adaptation of Management Policy: New Avoidance Criteria

Information gained through the Chemo I and Chemo II studies allowed MMS, through an adaptive approach, to develop more specific requirements and further refine its mitigation measures. Avoidance buffer distances between impacting activities and potential chemosynthetic communities were introduced in NTL 2000-20, which set specific, minimum separation distances from features, or areas, that "could" support high-density chemosynthetic communities. These included an avoidance distance of 305 m (1,000 ft) for the platform location and associated discharges and 76 m (250 ft) for anchoring and other physical impacts.

An important aspect of this policy is that avoidance was required for the "potential" presence of communities. Part of the increasing knowledge gained about these habitats included a better understanding of the geophysical signatures that were very strong indicators for the likely presence of living communities. The presence of these geophysical signatures (faults, hard bottom reflectivity, etc.) were used to define specific avoidance distances for the discharge locations of drilling muds[23] and cuttings and for all other proposed seafloor disturbances including anchors, anchor chains, wire ropes, seafloor template installations, and pipeline construction. Only submission of *in situ* imagery that demonstrated the absence of suspected chemosynthetic habitats would allow reconsideration of this risk-averse approach.

E. Monitoring of Impacts

Informed management and protection of this previously unknown resource is challenging without sufficient knowledge about all sources of potential impacts to these communities from energy development. In addition to the straightforward physical impacts of placing a structure or anchor on the seabed, additional potential impacts come from the discharge of cuttings and associated drilling fluids resulting from the drilling of wells. Several studies[24]

[23] Drilling fluids or "mud" is a fluid mixture composed primarily of the heavy natural mineral barite and is used in the drill pipe for the purpose of lubricating the drill bit and counter-weighting against internal pressure in the drilled hole.

[24] MINERAL MANAGEMENT SERVICE, GULF OF MEXICO OFFSHORE OPERATIONS MONITORING EXPERIMENT, PHASE I: SUBLETHAL RESPONSES TO CONTAMINANT EXPOSURE, FINAL REPORT, OCS Study/MMS 95-0045 (M. C. Kennicutt, II ed., 1995); CONTINENTAL SHELF ASSOCIATES, FINAL REPORT: GULF OF MEXICO COMPREHENSIVE SYNTHETIC BASED MUDS MONITORING PROGRAM (2004), *available at* http://www.gomr.mms.gov/PI/PDFImages/ESPIS/2/3050.pdf (Volume 1) and

have investigated drilling discharge impact sources in the past. However, these studies were located in shallower water than the habitat of chemosynthetic communities, which is generally deeper than 300 m (984 ft).

To monitor potential impacts from deepwater oil and gas drilling activities on chemosynthetic communities without harming them, MMS examined the direct effects of deepwater drilling on the sea floor in a number of areas uninhabited by chemosynthetic organisms. Contemporary with chemosynthetic habitat studies, a separate deepwater project was funded by MMS that specifically addressed the impacts of drilling in deepwater. This project, *Effects of Oil and Gas Exploration and Development at Selected Continental Slope Sites in the Gulf of Mexico,*[25] was awarded in June 2000. The objectives of this study were to assess the physical, chemical, and biological impacts of oil and gas development at selected exploration and development well sites on the GOM continental slope. Major objectives included documentation of drilling mud and cuttings accumulations, and physical modification/disturbance of the seabed due to anchors and mooring systems. All sites were at a water depth of approximately 1,100 m (3,609 ft).

Results showed drill cuttings and drilling fluid accumulations were evident mainly within a 500-m (1640-ft) radius near-field zone at all four sites (Figure 6), though there was geophysical and chemical evidence for deposits extending beyond this area. Physical impacts from anchoring were detected through side-scan sonar surveys. Individual anchoring-related scars ranged in length from less than 100 m (328 ft) to over 3 km (1.8 miles) and these extended from anchor locations toward the direction where the platform would have been located on the sea surface (Figure 7).

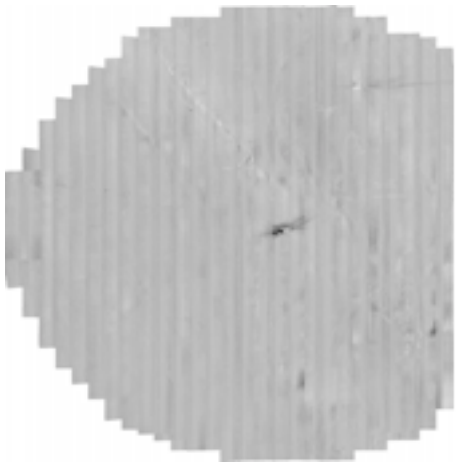

Fig. 6. Side-scan sonar mosaic at lease block Viosca Knoll 916 showing highly reflective bottom sediments representing drill cuttings discharge accumulations in the darker center area. The full figure has a diameter of about 6 km (3.7 miles). Cuttings discharge from a single exploratory well lies within a radius of 500 m (1,640 ft) in the center of the figure. Image from MMS-2006-045.

http://www.gomr.mms.gov/PI/PDFImages/ESPIS/2/3051.pdf (Volume II).

[25] CONTINENTAL SHELF ASSOCIATES, EFFECTS OF OIL AND GAS EXPLORATION AND DEVELOPMENT AT SELECTED CONTINENTAL SLOPE SITES IN THE GULF OF MEXICO, VOLUME II: TECHNICAL REPORT, OCS Study/MMS 2006-045 (2006), *available at* http://www.gomr.mms.gov/PI/PDFImages/ESPIS/3/3875.pdf.

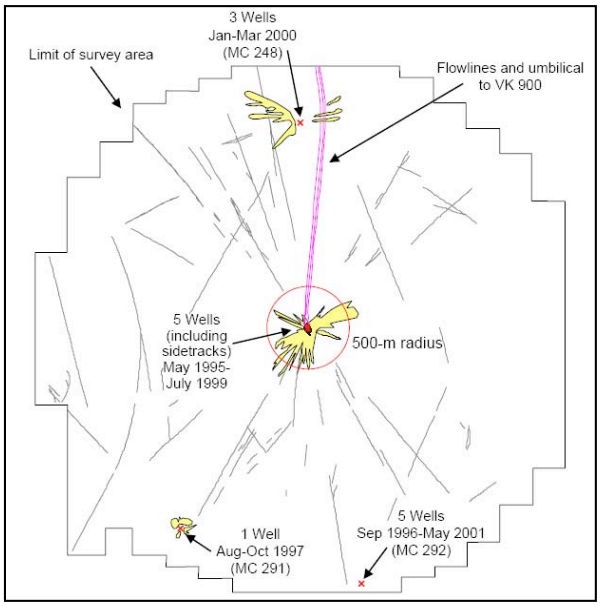

Fig. 7. This is the interpreted diagram using the side-scan sonar mosaic for a production drilling site at block Mississippi Canyon 292. High reflectance from side scan data at well sites is interpreted as drilling discharge accumulations. Linear marks represent impacts from anchor chains/rope. Image from MMS-2006-045.

Results from this study were utilized immediately in consideration of the evidence for more extensive impacts from anchor chains or wire ropes. Rather than limiting consideration of impacts from only the anchor location and lengths of chain/rope expected to be in contact with the bottom after installation, the full distance from the anchor point to the platform location was included in the bottom area evaluated for potential impacts. From the study of the distances reached by sinking muds and cuttings discharges, the avoidance policy was adapted once again, although delays were encountered with respect to the release of the official NTL (see Section IV below).

F. Additional Study: The Deep Missing Piece

Yet another challenge for fully understanding the distribution and ecology of chemosynthetic communities throughout the full depth range of the GOM has been the difficulty in studying the deepest parts of their environment. Throughout the initial two studies, Chemo I and Chemo II, research was largely restricted to the depth capabilities of the available facilities, the *Johnson Sea Link* submersibles and the Navy's *NR 1* research submarine used for a portion of Chemo II. All of these submarines are limited to a maximum depth of about 1,000 m (3,280 ft) while the deepest part of the GOM continental slope with visual evidence of the presence of chemosynthetic communities reaches a depth of at least 2,743 m (9,000 ft). A third major study was therefore necessary to investigate this missing piece. This new study, to be completed in mid-2010, is specifically targeted for water depths greater than 1,000 m (3,280 ft). Funding for the study, *Investigations of*

Chemosynthetic Communities on the Lower Continental Slope of the Gulf of Mexico (Chemo III), was awarded in 2005.[26]

This new project had an additional advantage of full partnership with other Federal agencies. Through sponsorship of the National Oceanographic Partnership Program,[27] NOAA's Office of Ocean Exploration and Research (OER) was a partner in this large study, providing research vessel and submergence facility support over the two field years of the four-year project. Scientists with the U.S. Geological Survey also conducted companion studies directly tied to the overall objectives of MMS. For the MMS/NOAA OER field work, the submersible *Alvin* was used in 2006 and the premiere research ROV, *Jason II* from Woods Hole Oceanographic Institution, was used in 2007. Both of these expeditions lasted nearly a month each. These two cruises were designated "signature expeditions" by NOAA and are extensively documented with daily logs, outreach materials, and images on NOAA's Ocean Explorer website.[28]

Basic discoveries during this study demonstrated that chemosynthetic communities can be present throughout the deep GOM anywhere characteristic geophysical signatures exist. Results indicated that species composition at these much deeper sites was generally completely different than the shallower slope communities. The most important aspect of these studies was the development of the essential knowledge BOEMRE needs to fully understand the entire habitat range for these communities throughout the GOM.

IV. Additional and Ongoing Adaption of Management Policy

With new information derived from MMS-funded studies including direct field measurements of the distances that deepwater drilling discharges are deposited over the seabed, additional modifications to avoidance policy for the protection of chemosynthetic communities was indicated. Other contemporary studies were also investigating cold-water coral habitats that are closely associated with the same habitat areas as chemosynthetic communities.[29] These studies were also utilized in this most recent adaptive management phase.

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[26] Two interim reports are currently available. JAMES M. BROOKS ET AL., INVESTIGATIONS OF CHEMOSYNTHETIC COMMUNITIES ON THE LOWER CONTINENTAL SLOPE OF THE GULF OF MEXICO: INTERIM REPORT 1, OCS Study/MMS 2008-009 (2008), *available at* http://www.gomr.mms.gov/ PI/PDFImages/ESPIS/4/4320.pdf; JAMES M. BROOKS ET AL., INVESTIGATIONS OF CHEMOSYNTHETIC COMMUNITIES ON THE LOWER CONTINENTAL SLOPE OF THE GULF OF MEXICO: INTERIM REPORT 2, OCS Study/MMS 2009-046 (2009), *available at* http://www.gomr.mms.gov/ PI/PDFImages/ESPIS/4/4877.pdf .

[27] The National Oceanographic Partnership Program (NOPP), http://www.nopp.org/, is a collaboration of federal agencies to provide leadership and coordination of national oceanographic research and education initiatives.

[28] *See*, NOAA Ocean Explorer, Expedition to the Deep Slope, May 7 – June 2, 2006, http://oceanexplorer.noaa.gov/explorations/06mexico/welcome.html; NOAA Ocean Explorer, Expedition to the Deep Slope 2007, June 4 – July 6, 2007, http://oceanexplorer.noaa.gov/ explorations/07mexico/welcome.html (last visited June 17, 2010).

[29] CSA International 2007, *supra* note 8; Ongoing BOEM/NOAA collaboration study, Exploration and Research of Northern Gulf of Mexico Deepwater Natural and Artificial Hard Bottom Habitats with Emphasis on Coral Communities: Reefs, Rigs and Wrecks (*Lophelia* II) (GM 08-03),

Several significant components of the previous NTL 2000-G20 were modified based on new information including: (1) the minimum depth of activity requiring individual action reviews, (2) the buffer distances required for separation from surface discharges from potential community locations, and (3) the buffer distance required for separation from other physical impacts such as anchoring.

Deep coral habitat research influenced the adaptive change that decreased the minimum depth for site-specific biological reviews required for all drilling plans or pipeline installation applications submitted to MMS from 400 m (1,313 ft) up to 300 m (984 ft). This was largely due to one of the most remarkable deep coral habitats discovered at a depth of 305 m (1,000 ft) in lease block Viosca Knoll 906.[30] The most recent adaption of policy as of this writing was finalized in NTL 2010-G40, *Deepwater Benthic Communities.*[31] Buffer distances for discharges were increased from 305 m (1,000 ft) to 610 m (2,000 ft), as a direct result of research findings. Avoidance distances were also increased from 76 m (250 ft) to 152 m (500 ft) for other physical impacting activities such as anchors. An additional 305-m (1,000-ft) buffer radius is added to anchor patterns when in the vicinity of probable chemosynthetic communities to prevent possible inadvertent contact with the communities.

The adaptation of management policy for the protection of deep GOM biological communities will continue in the future. To date, it appears that existing protective measures have been effective. Several chemosynthetic communities have been studied on a regular basis for many years and no detectable degradation has occurred that could be attributed to man's activities.

http://www.gomr.mms.gov/homepg/regulate/environ/ongoing_studies/gm/GM-08-03.html (last visited June 17, 2010).

[30] This site was "rediscovered" through direct participation of MMS and use of archived seismic data guiding a mission using the Navy's *NR 1* submarine to an area thought to be the same as the area described by Donald R. Moore and Harvey R. Bullis Jr. in *A Deep-water Coral Reef in the Gulf of Mexico,* BULL. MAR. SCI. 10(1): 125-128 (1960) and reported by William Schroeder in *Seafloor Characteristics and Distribution Patterns of* Lophelia pertusa *and other Sessile Megafauna at Two Upper-slope Sites in Northeastern Gulf of Mexico*, *supra* note 8.

[31] NTL 2010-G40, Deepwater Benthic Communities NTL implemented January 27, 2010, *available at* http://www.gomr.mms.gov/homepg/regulate/regs/ntls/2009NTLs/09-G40.pdf .

Conservation Easements and Adaptive Management

Jesse J. Richardson, Jr.[1]

> Current environmental law … rests on a simple ecological paradigm which the science has now rejected and replaced with a more complex, open-ended model. The idea that "Nature knows best: leave her alone" fit with the secular-spiritual preservation movement which transformed itself into environmentalism in the 1960s. "Leave her alone" principles derive from classic ecological theories which posited equilibrium as the highest state of natural systems and viewed ecosystems as inherently fragile and thus vulnerable to human degradation.[2]

Abstract: The perpetual nature of conservation easements makes adaptive management difficult on easement property. Various easement provisions may be used to incorporate adaptive management principles into a conservation easement, but various factors, including state statutory requirements and Internal Revenue Code requirements for deductibility, limit the flexibility of management on conservation easement lands. Jesse Richardson discusses how conservation easements limit implementation of adaptive management principles on protected lands. Case studies of conservation easements that now fail to fulfill the original conservation purpose, but are locked into perpetual conservation, illustrate the limitations of conservation easements. Richardson also discusses likely future conflicts between conservation easements and adaptive management techniques to address such things as sea level rise and the preservation of endangered species habitat. In the conclusion, Richardson proposes several legal and policy changes to reform conservation easements in order to accommodate and facilitate adaptive management on conservation easement lands.

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[2] Fred P. Bosselman and A. Dan Tarlock, *The Influence of Ecological Science on American Law: An Introduction*, 69 CHI-KENT L. REV. 847, 847 (1996).

I. Introduction

Conservation easements are a very popular land conservation tool. The Uniform Conservation Easement Act defines "conservation easement" as "a nonpossessory interest of a holder in real property imposing limitations or affirmative obligations the purposes of which include retaining or protecting natural, scenic, or open-space values of real property, assuring its availability for agricultural, forest, recreational, or open-space use, protecting natural resources, maintaining or enhancing air or water quality, or preserving the historical, architectural, archaeological, or cultural aspects of real property."[3] The use of "easement" is a bit of a legal misnomer, since conservation easements involve negative restrictions on the use of the property.[4] "Easement" is generally defined as a "right of use over the property of another."[5] Common easements include utility easements and easements of ingress and egress (commonly referred to as "rights of way").

More accurately, such interests in land should be referred to as "covenants" or "servitudes."[6] The restrictions in a conservation easement resemble restrictive covenants in many subdivisions. A conservation easement is of unlimited duration unless the deed sets out a different term.[7]

Reliable data is difficult to locate on conservation easements.[8] However, the number of easements has skyrocketed over the past several years. According to a 2005 census conducted by the Land Trust Alliance, local, state, and national land trusts held easements on 37 million acres, a 54% increase from 5 years earlier.[9] The actual number of conservation easements is probably much higher, as the Land Trust Alliance included large

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[3] Unif. Conservation Easement Act § 1(1) (amended 2007), *available at* http://www.law.upenn.edu/bll/archives/ulc/ucea/2007_final.htm [hereinafter *UCEA*].

[4] Gerald Korngold, *Solving the Contentious Issues of Private Conservation Easements: Promoting Flexibility for the Future and Engaging the Public Land Use Process*, 2007 UTAH L. REV. 1039, 1052 (2007).

[5] Black's Law Dictionary, 509 (6th Ed. 1990).

[6] Korngold, *supra* note 4; *see also*, Julia D. Mahoney, *Land Preservation and Institutional Design*, 23 J. OF ENVTL. L. AND LITIG. 433 (2008) (using the term "conservation servitudes" throughout).

[7] UCEA, *supra* note 3, § 2(c).

[8] Gerald Korngold, *Private Conservation Easements: Balancing Private Initiative and the Public Interest, in* PROPERTY RIGHTS AND LAND POLICIES 367 (Gregory K. Ingram & Yu-Hung Hong eds, 2009).

[9] Land Trust Alliance, 2005 National Land Trust Census, http://www.landtrustalliance.org/about-us/land-trust-census/census/ (last visited March 20, 2010).

national land trusts like the Nature Conservancy and Ducks Unlimited, but failed to count easements held by a number of governmental agencies.[10] The pace of conservation by state and local land trusts more than tripled between 2000 and 2005.[11] In addition, the number of land trusts grew to 1,667, a 32% increase from 2000.[12] Federal and state tax incentives spur much of the growth of conservation easements.

The use of conservation easements, however, presents challenges for land managers trying to adapt to emerging environmental problems. In recent years, land managers have been encouraged by academics and policy-makers to follow the principles of adaptive management. "Adaptive management is a formal, systematic, and rigorous program of learning from the outcomes of management actions, accommodating change and improving management."[13] Adaptive management entails "the integration of design, management, and monitoring to systemically test assumptions in order to adapt and learn."[14] The process of adaptive management consists of eight steps: (1) define the problem; (2) determine the goals and objectives for the management of the ecosystems; (3) determine the ecosystem baseline; (4) develop the conceptual models; (5) select future restoration actions; (6) implement and manage; (7) monitor and observe the ecosystem response; and (8) evaluate the restorative efforts and propose remedial actions.[15]

Some scholars view adaptive management techniques as essential for environmental protection, since standard approaches in environmental law and management have failed with respect to complex issues like invasive species, nonpoint source pollution, and habitat loss.[16] Both the number of complex issues and the depth of the complexities are likely to dramatically increase in the future and the specter of climate change presents a completely different sort of issue that requires the use of adaptive management.[17]

Unfortunately, the implementation of adaptive management techniques faces institutional barriers. "The theory of adaptive management – what is meant by the words – is quite well established. It is the practice of adaptive management – what to do to make those words come true – that has been far more elusive to get on the page."[18] Ruhl argues that the "hostile environment" in which administrative agencies presently operate make adaptive management impossible.[19] High-stakes litigation, which relies on large amounts of public participation, judicial review, congressional oversight and political maneuvering, presently

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[10] *Id.*
[11] *Id.*
[12] *Id.*
[13] COMMISSION ON ENDANGERED AND THREATENED FISHES IN THE KLAMATH RIVER BASIN, NATIONAL RESEARCH COUNCIL, ENDANGERED AND THREATENED FISHES IN THE KLAMATH RIVER BASIN: CAUSES OF DECLINE AND STRATEGIES FOR RECOVERY 332 (2004) [hereinafter *NRC Klamath River Report*].
[14] NICK SALAFSKY, RICHARD MARGOLIS AND KENT REDFORD, ADAPTIVE MANAGEMENT: A TOOL FOR CONSERVATION PRACTITIONERS 12 (2001), *available at* http://www.fosonline.org/Site_Docs/AdaptiveManagementTool.pdf .
[15] NRC Klamath River Report, *supra* note 13, at 333-35.
[16] J.B. Ruhl, *It's Time to Learn to Live With Adaptive Management (Because we Don't Have a Choice)*, 39 ENVTL. L. REP. 10920, 10921 (Oct. 2009).
[17] *Id.*
[18] *Id.* at 10920.
[19] *Id.* at 10921-22.

drives the system.[20] For adaptive management to be implemented, the system must be transparent, accountable, and far less adversarial than at present.[21]

The theory of adaptive management shares several characteristics with the use of conservation easements. Both concepts possess fairly short histories, having either originated in or become prevalent in the past thirty-five years. In addition, the popularity of both as a means for environmental protection greatly increased during the same time period.

Adaptive management and conservation easements, however, can at times be diametrically opposed. Adaptive management takes as a given the dynamic, ever-changing character of nature and natural processes. Conservation easements, like most other current environmental law regimes, assume a "static and unchanging" natural environment.[22] While adaptive management involves accommodating change through learning, conservation easements generally set out fixed restrictions on land use that purport to govern into perpetuity.[23] Adaptive management embraces and depends upon changing management approaches. Changes to conservation easements prove to be extremely difficult, often requiring court approval.

This article explores whether these two seemingly contradictory approaches can be reconciled to advance environmental protection. Section II presents an overview of adaptive management and conservation easements. Section III examines approaches to drafting conservation easement that can maximize the possibility of adaptive management of the protected lands. Section IV examines judicial doctrines that may hinder or aid in the amendment or termination of conservation easements so that adaptive management processes may be applied to management of the eased property. Section V highlights "rolling easements," a variant of conservation easements that holds the promise to incorporate adaptive management in the coastal context. Finally, Section VI discusses alternatives to perpetual conservation easements that better allow the implementation of adaptive management to conservation lands.

II. Barriers to Managing Conservation Easement Lands Adaptively

The explicit purpose of a conservation easement is to restrict land use options in the future.[24] It is important to note that the term "conservation easement" is a slight misrepresentation of the tool, as conservation practices are not always required.[25] In practice, conservation easements extinguish the right to develop the property. In recognition of this true nature of conservation easements, government agencies and land

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[20] *Id.* at 10921.
[21] *Id.* at 10922.
[22] Julia D. Mahoney, *Perpetual Restrictions on Land and the Problem of Future*, 88 VA. L. REV. 739, 756 (2002).
[23] Duncan M. Greene, *Dynamic Conservation Easements: Facing the Problem of Perpetuity in Land Conservation,* 28 SEATTLE UNIV. L. REV. 883, 884 (Spring 2005).
[24] Mahoney, *supra* note 22, at 743-44.
[25] Jesse J. Richardson, Jr., *Maximizing Tax Benefits of Farmers and Ranchers Implementing Conservation and Environmental Plans*, 48 OKLA. L. REV. 449 (1995).

trusts often call conservation easement purchasing programs "purchase of development rights programs."

Federal and state tax incentives spur much of the growth of conservation easements, and add to the rigidity of the tool. Section 170(h) of the Internal Revenue Code (IRC) allows a federal income tax deduction for a "qualified conservation contribution," which includes conservation easements that meet the requirements of the IRC and implementing regulations. The Internal Revenue Service (IRS) bases the value of the donation not on conservation values, but on the value of the forgone development rights. Many states allow a deduction for state income tax purposes and some grant state income tax credits for donations of conservation easements.[26] In addition, in theory at least, a donation of a conservation easement reduces the value of the burdened property. Consequently, local real property taxes may be reduced.[27]

The vast majority of conservation easements are perpetual. For example, in 2003, federal taxpayers deducted a total of $1.49 billion for contributions of perpetual conservation and historic easements.[28] This predominance of perpetual easements results, in part, from the fact that in order to take advantage of the federal income tax benefits afforded to qualifying donations of conservation easements, the easement must be perpetual.[29] In addition, land trusts and environmentalists generally express a strong preference for perpetual easements.

The perpetual nature of most conservation easements necessitates a static approach that conflicts with the dynamic nature of ecosystems.[30] The restrictions contained in conservation easements, although written at the initiation of the easement, govern into perpetuity. Amendments prove difficult to implement. Other methods to introduce flexibility into these rigid instruments introduce uncertainty and conflict with the intent of easements to freeze the property in time, as discussed in subsequent sections of this paper.

Conservation easements, by design, fail to allow adequate adaption to rapid changes in scientific knowledge and the environment. Nature and scientific knowledge constantly change and huge transformations occur, sometimes abruptly.[31] Perpetuity proves especially problematic in light of climate change and rising sea levels, which accelerate the rate of change.[32] "The touchstone of conservation easements has not been flexibility but rather strict adherence to the status quo. These perpetual property interests are designed to

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[26] Nicole Sandberg, State Income Tax Deductions for Conservation Easements (2008) (unpublished manuscript, on file with author); CONSERVATION RESOURCE CENTER, STATE CONSERVATION TAX CREDITS: IMPACT AND ANALYSIS 9 (2007), *available at* http://www.taxcreditexchange.com/documents/StateConservationTaxCreditsImpactandAnalysis.pdf .

[27] Korngold, *supra* note 8, at 365.

[28] JANETTE WILSON AND MICHAEL STRUDLER, INTERNAL REVENUE SERVICE, INDIVIDUAL NONCASH CHARITABLE CONTRIBUTIONS 60 (2003), *available at* http://www.irs.gov/pub/irs-soi/03inccart.pdf .

[29] I.R.C. § 170, 26 U.S.C. § 170(h)(4)(A)(iii).

[30] John Echeverria and Jeff Pidot, *Drawing the Line: Striking a Principled Balance Between Regulating and Paying to Protect Land*, 39 ENVTL L. REP. 10868, 10874 (2009).

[31] Mahoney, *supra* note 6, at 442.

[32] Echeverria and Pidot, *supra* note 30, at 10874.

forever preserve the current natural or ecological state of the burdened property."[33] Conservation easements essentially seek to "freeze" the allowable uses of land forever.[34]

Additionally, when strictly enforced, conservation easements limit land use options in the future and limit the choices of future generations.[35] Conservation easements are based on the assumption that so long as humans do not interfere with the land, protected lands will stay the same forever.[36] By imposing perpetual, inflexible restrictions that fail to allow for changes, creators of conservation easements assume they are in a better position to make decisions for future generations than the future generations themselves. However, since scientific knowledge is constantly advancing, later generations will almost certainly possess better information with which to make land use decisions.[37] Future generations will also have the benefit of learning from the past successes and failures of the present generation. Additionally, because social values may change from generation to generation, choices made in the present may not fit the values of future generations.[38]

Perpetual conservation easements are appropriate in some circumstances. Where conservation values are extremely high and those conservation values are likely to endure into perpetuity, perpetual protection is warranted. Even the U.S. Congress used such terms as "rare" and "unique" in describing conservation easements eligible for the federal income tax deduction when the legislation was first proposed.[39] As an extreme example, the Grand Canyon would be ideal for a perpetual conservation easement. A working farm, however, may not be a good candidate. Unless the farm lies upon extremely valuable soils, for example, the farm's current conservation values may or may not be present in 20 or 50 years as agriculture and the economics of agriculture change.

In many situations, however, other land use planning tools offer more benefits. For example, more traditional types of land conservation practices, such as zoning, may be better suited to incorporating adaptive management principles. Regulation and fee-simple purchases of land leave the future decisions to future generations and are not as costly to change.[40] If a local government passes a land use regulation that proves to be ineffective or counterproductive at some future time, or if community values change, the local government need merely amend or repel the legislation. Staying with the farmland example, if agriculture is no longer economically viable in that area or if development patterns make the land more appropriate for development, the zoning may be changed.

In addition, land use planning and regulation advance over the years,[41] sometimes through adaptive management processes. When land use planning tools are found to be lacking,

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[33] Gerald Korngold, *Resolving the Intergenerational Conflicts of Real Property Law: Preserving Free Markets and Personal Autonomy for Future Generations*, 56 AM. U. L. REV. 1525, 1574 (2007).
[34] Mahoney, *supra* note 6, at 442.
[35] Mahoney, *supra* note 22, at 744.
[36] Mahoney, *supra* note 6, at 443.
[37] *Id.* at 444-45.
[38] *Id.*
[39] S. Rep. 96-1007, 96th Cong., 2nd Sess. 1980, 1980 U.S.C.C.A.N. 6736, 6743-51 (1980).
[40] Mahoney, *supra* note 22, 744-45.
[41] Mahoney, *supra* note 6, 444-45.

practices change to obtain better results. For example, Euclidean land use zoning continues to evolve away from strict Euclidean segregation of land uses.

Euclidean zoning involves dividing a land area into different use classifications called zoning districts. Each zoning district allows certain land uses and prohibits others. In Euclidean zoning, strict segregation of land uses result, so that single-family residential areas are separated from multi-family residential areas, which are separated from retail areas, and so on. Cluster development (grouping housing units on one part of the property on small lots, with the remaining portion of the property retained as open space), planned unit development (mixed-use developments planned on a development-level basis), form-based codes (restrictions based on the form of the structure, not use) and other innovations have in recent years introduced much-needed flexibility into zoning.

In fact, conservation easements themselves have benefited from a form of adaptive management and have improved over the decades.[42] Earlier easements appear primitive in relation to the deeds of today. Through trial and error, the conservation easement industry has learned better ways to draft easements to incorporate the lessons of earlier mistakes.[43] Unfortunately, the mistakes made in earlier easements generally are difficult to correct.

III. Drafting Conservation Easements to Incorporate Adaptive Management Principles: The Case of Working Lands

A. Introduction

One means of incorporating adaptive management principles into conservation easements is to draft the easement in a way that will allow for adaptive management. Adaptive management principles can be incorporated into a conservation easement either explicitly or implicitly.[44]

The purpose clause provides the key central framework for the conservation easement.[45] A purpose clause that expressly states that adaptive management principles shall be applied explicitly incorporates adaptive management.[46] The drafter, however, may implicitly incorporate adaptive management principles by referring to an external management or conservation plan that may be reviewed and updated periodically.[47] In either case, adaptive management requires intensive monitoring programs.[48]

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[42] George T. Davis, Protecting Scenic Views: Seventy Years of Managing and Enforcing Scenic Easements Along the Blue Ridge Parkway (May 2009) (unpublished Virginia Tech Masters Thesis, on file with author); LAND TRUST ALLIANCE, AMENDING CONSERVATION EASEMENTS: EVOLVING PRACTICES AND LEGAL PRINCIPLES 19 (2007).

[43] *See, e.g.,* Adena R. Rissman, *Designing Perpetual Conservation Agreements for Land Management*, RANGELAND ECOLOGY & MGMT. 63: 167-75 (March 2010).

[44] Greene, *supra* note 23, at 920.

[45] Dan Tesini, *Working Forest Conservation Easements*, 41 URB. LAW. 359, 359-60 (2009).

[46] Greene, *supra* note 23, at 920.

[47] *Id.*

[48] *Id., citing* NATIONAL COMMISSION ON SCIENCE FOR SUSTAINABLE FORESTRY, SCIENCE, BIODIVERSITY, AND SUSTAINABLE FORESTRY 35 (2005), *available at* http://ncseonline.org/ewebeditpro/items/O62F4867.pdf .

In addition, many conservation easements contain amendment provisions.[49] These amendment provisions allow the landowner and the easement holder to agree to changes in the conservation easement, so long as the changes do not interfere with the purposes of the easement.[50] Even without an amendment provision in the easement, an implied power to amend may exist, so long as the amendment is consistent with the purpose of the easement.[51] However, uncertainty surrounds this possibility, and court action may be necessary to determine whether the power to amend exists and, if so, the extent of that power.

Conservation easements on working lands present particular challenges. The conservation values for these lands rest in the production of food or fiber. These values are not inherent in the property itself, nor are these values as unlikely to change in the future as, for example, a very beautiful and natural formation or landmark such as the Grand Canyon. In addition, if the land may not be profitably farmed or forested, the conservation values are greatly diminished. Easements for working lands must therefore balance the need to both protect the conservation values and avoid "prescribing techniques and requirements that will become outdated or impractical for the landowner to uphold or for the land trust to monitor."[52]

B. Working Forestland Easements

Working forestlands are often the subject of conservation easements. For example, the U.S. Department of Agriculture's Forest Service administers the Forest Legacy Program. According to the Forest Service, the Forest Legacy Program "protects 'working forests' those that protect water quality, provide habitat, forest products, opportunities for recreation and other public benefits."[53]

The application of adaptive management principles to conservation easements appears to be most advanced with respect to forestland. Perhaps not coincidentally, working forestland conservation easements receive the most attention with respect to incorporation of adaptive management techniques. This section describes the ways that adaptive management principles may be included in working forestland easements and also discusses whether adaptive management principles are actually incorporated in practice.

The purpose of a working forestlands conservation easement necessarily addresses conservation values and the production values.[54] Site-specific conservation values and production values must be balanced in the language of the easement.[55] Consequently,

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[49] Nancy A. McLaughlin, *Commentary on Gerald Korngold, Private Conservation Easements: Balancing Private Initiative and the Public Interest, in* PROPERTY RIGHTS AND LAND POLICIES 382 (Gregory K. Ingram & Yu-Hung Hong eds., 2009).
[50] *Id.*
[51] *Id.*
[52] Kendall Slee, *Evolving Easements on Working Forestlands*, EXCHANGE, THE JOURNAL OF THE LAND TRUST ALLIANCE 17(2): 5 (1998).
[53] U.S. Dept. of Agriculture Forest Service, Forest Legacy Program, http://www.fs.fed.us/spf/coop/programs/loa/flp.shtml (last visited July 21, 2010).
[54] Greene, *supra* note 23, at 918.
[55] *Id.*

working forestland easements require more detailed baseline documentation than other types of easements in order to properly establish and balance these values.[56]

The goals and objectives section of the easement sets out detailed plans for the property. These plans may be set out very generally with broad parameters, giving the landowner more authority to make decisions.[57] Alternatively, goals and objectives may be very specifically described, leading to management aimed at a particular desired condition.[58] More detailed goals and objectives entail more costly monitoring to ensure compliance.[59]

The restrictions and retained rights section of the easement delineates the acceptable means by which the purposes, goals, and objectives may be achieved.[60] The restrictions and retained rights may be contained within the body of the easement or be included in an external set of restrictions. If the drafter includes the restrictive language within the body of the easement, adaptation to changes in weather, markets and technology may be difficult or impossible.[61] In addition, evolutions in scientific understanding, advancements in technology and changed social conditions cannot be incorporated into such restrictions.[62] "The worst nightmare of any land manager is to be bound to manage land to its own detriment by an outdated set of restrictions."[63]

Further, one may include restrictions within the body of the easement using three different methods. First, the restrictions may merely be written into the body of the easement.[64] Second, the easement may refer to "sustainable forestry" practices as an imprecise restriction.[65] Finally, the easement may omit any reference to restrictions and rely on local, state, and federal law.[66]

None of these three practices adequately incorporates adaptive management principles. Listing the restrictions in the easement locks the landowner into practices that may be counterproductive, or worse. For example, an easement may prohibit clearcutting. In the future, however, a situation may arise, perhaps involving a disease or pest, where clearcutting is the best harvesting method to protect the ecological values of the property. The rigid restriction on clearcutting will prevent managers from protecting ecological values to the maximum extent possible.

On the other hand, relying on the vague notion of "sustainable forestry" creates uncertainty and may lead to future disputes over competing notions of what values should be sustained.[67] Defining "sustainable forestry" in the easement document ties the parties to a

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[56] *Id.*
[57] Tesini, *supra* note 45, at 360-61.
[58] *Id.*
[59] *Id.*
[60] *Id.* at 361.
[61] *Id.*
[62] *Id.*
[63] *Id.*
[64] *Id.*
[65] *Id.* at 362.
[66] *Id.* at 361.
[67] *Id.* at 368.

notion of sustainability that may later prove to be unsustainable.[68] Finally, while local, state and federal laws change over time, the changes will likely occur for political and other reasons unrelated to adaptive management.

A better option for incorporating adaptive management principles into forestland conservation easements might be to refer to external standards such as best management practices, sustainable forest product certification standards or forest management plans drafted by a certified forester.[69] The inclusion of sustainable forest product certification standards within the easement holds certain advantages over best management practices or general references to sustainable forestry. These principles represent a high standard, receive regular updates, rely on independent third-party auditors, require regular monitoring, and allow the potential for higher returns on investment through premium product markets.[70] However, certification standards represent general standards that fail to incorporate specific characteristics of individual parcels.[71] In addition, the certification standards do not necessarily change due to adaptive management techniques. The generality of the standards necessarily implies a lack of site-specific experimentation.

Adaptive management principles may also be incorporated by listing restrictions in a separate forest management plan, which can then be adjusted to adapt to changed conditions.[72] Some states require forest management plans for the property to qualify to be taxed based on the land's value in use (use-value assessment) as opposed to fair market value.[73] A forest management plan sets forth management objectives and specific practices to be used to achieve the objectives. Forest management plans allow a degree of flexibility and adaptation to changing conditions that contrasts sharply with the alternative of attempting to delineate management restrictions within the conservation easement.[74]

Conservation easements incorporating forest management plans generally require that professional foresters prepare the plans. Land trusts generally use three approaches with respect to review and approval of forest management plans: (1) the easement holder may retain the right to review and approve the plan; (2) the easement holder may retain review, but not approval rights, and may give notice of any easement violations; or (3) the easement holder retains no right to review or approve the plan.[75]

Forest management plans offer several advantages over other means of incorporating adaptive management into conservation easements. Forest management plans allow tailoring for individual properties, permit a reduction in prescriptive language included in the easement, and provide clear guidance for future monitoring and enforcement.[76] Most importantly for adaptive management, forest management plans may be continuously

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[68] *Id.*
[69] *Id.* at 361.
[70] *Id.* at 368-69.
[71] *Id.* at 369.
[72] *Id.* at 361; Greene, *supra* note 23, at 918-19.
[73] *Id.*
[74] Tesini, *supra* note 45, at 369.
[75] *Id.*
[76] *Id.*

amended and reformulated to reflect changed conditions, incorporate new technology and knowledge, and respond to disasters.[77]

Even where the possibility of adaptive management exists, the monitoring required to facilitate continuous reformulation of management practices is often lacking. "[M]onitoring is the foundation of 'adaptive management' by which new knowledge about managing resources and ecosystems will be developed and systematically incorporated into management plans."[78] The cost of perpetual monitoring and stewardship often cause conservation easements to fail.[79] Fundraising for stewardship often proves more difficult than fundraising for acquisition of conservation easements.[80] As a result, land trusts tend to focus almost exclusively on acquisition of additional conservation easements, relegating monitoring and stewardship to the lowest funding priority.

In practice, working forest easements in many cases fail in even the attempt to incorporate adaptive management principles. A 2004 survey of non-governmental organizations (for example, land trusts) and government agencies holding conservation easements found that only 63% of organizations and 75% of government agencies allowed harvesting of non-native and undesirable trees.[81] Forty-five percent of organizations and 27% of agencies prohibited clearcutting on working forest easements.[82] With respect to desires to restrict certain practices in working forestland conservation easements, both organizations and agencies placed high priority on restricting the use of chemicals.[83] These restrictions appear in the easement document, foreclosing the use of these practices unless the easement holder utilizes a costly amendment process.

More disturbing with respect to adaptive management, only 44% of the organizational respondents reported completing a baseline forest inventory prior to execution of a working forest conservation easement, while only 38% of agencies completed a forest inventory.[84] Organizations reported a stewardship or management plan on 62% of working forest conservation easements, while government agencies reported that requirement on 69% of properties.[85] Survey participants were also asked whether forest records estimating total forestland area and/or number of easements over ten acres were kept.[86] Only 45% of organizations and 28% of agencies kept such records.[87]

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[77] *Id.*
[78] Adam Block et al., Trends in Easement Language and the Status of Current Monitoring on Working Forest Conservation Easements 34 (April 2004) (Unpublished University of Michigan Masters Project, University of Michigan), *available at* http://www.snre.umich.edu/ecomgt//pubs/wfce/wfcecomplete.pdf.
[79] Tesini, *supra* note 45, at 372.
[80] *Id.*
[81] Michael J. Mortimer, Jesse J. Richardson, Jr., Jeffrey S. Huff, and Harry L. Haney, Jr., *A Survey of Forestland Conservation Easements in the United States: Implications for Forestland Owners and Managers*, 6 SMALL-SCALE FORESTRY 35, 39 (2007), *available at* http://www.springerlink.com/content/x60h230682414h41/ .
[82] *Id.*
[83] *Id.*
[84] *Id.*
[85] *Id.*
[86] *Id.*
[87] *Id.*

The lack of baseline information and detailed monitoring makes incorporation of adaptive management principles even more difficult in working forestland easements. Even though the incorporation of these principles has advanced further in working forestland easements than in other areas, implementation remains problematic.

The inclusion of restrictions on certain forest practices may result from a lack of expertise on behalf of land trust and government agency staff with respect to forestry practices. Land trust and governmental agency staff often lack education or training in forestry. Consequently, blanket restrictions on techniques like clearcutting and chemical application often focus on "hot button" issues and fail to consider scientific evidence that supports these practices.

Failure to include appropriate baseline reports and failure to monitor reflect a common focus on acquisition of more and more easements in order to "prevent" development. Politically, a land trust or government agency can garner more support by focusing on acquisition activities. As mentioned above, baseline information and monitoring involve more mundane tasks that often fail to receive adequate funding.

C. Working Farmland Easements

Many conservation easements seek to protect working farmland. The donors desire to see the agricultural use continue into perpetuity. Working farmland easements prove more difficult than forestland easements with respect to incorporation of adaptive management principles. While forestland easements basically limit themselves to one "crop," timber, working farmland conservation easements may involve a broad range of agricultural products and production processes. Drafting to include this broad range of possibility proves to be problematic.

The purpose clause again is important and should be drafted broadly to allow flexibility.[88] If more than one purpose supports the easement, each purpose should be stated and a standard for resolving conflict between the purposes should be included within the document.[89]

A district court case from Kentucky, *The Nature Conservancy v. Sims,*[90] illustrates the importance of the purpose clause. Sims purchased a 100.10-acre tract from The Nature Conservancy (TNC) in 2001 and placed a conservation easement on the property one week later. Based on an inspection of the property in 2005, TNC filed a complaint seeking injunctive relief for several alleged violations of the easement. TNC alleged that Sims violated the terms of the easement by filling and re-grading a sinkhole located behind the residence with soil excavated from a pond on the property. Sims claimed he filled the hole because it was too difficult and dangerous to farm around the sides of the basin of the sinkhole.

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[88] Greene, *supra* note 23, at 915.
[89] *Id.*
[90] 2009 WL 602031 (E.D. Ky. March 5, 2009).

The purpose of the easement was to "assure that the [property] will be retained forever substantially undisturbed in its natural condition and to prevent any use of the [property] that will significantly impair or interfere with the Conservation Values of the [property]."[91] Paragraph 2.5 of the easement prohibited "ditching; draining; diking; filling; excavating; removal of topsoil, sand, gravel, rock or other materials; or any change in the topography of the land in any manner *except in conjunction with activities otherwise specifically authorized herein.*[92] Paragraph 3.2 stated, in pertinent part, that "[n]otwithstanding the foregoing provisions of paragraph 2, the Residential/Agricultural Area of the Protected Property … may be used for commercial agricultural purposes [including a list of agricultural activities, including growing crops]…"[93] Prior to the filling the sinkhole, Sims was growing crops around, and possibly in, the sinkhole.[94] The court, focusing on the purpose clause, found that the plain language of the easement made Sims' interpretation unreasonable.

In addition to clearly stating the purpose, the easement should include definitions of "agriculture" and other terms that allow for changes over time as the industry adapts to changing conditions.[95] Agriculture is a dynamic and changing industry that encompasses a broad and uncertain category of activities. Wind turbines, biodiesel production, and solar power generation are all potentially agricultural-related. A wide-range of activities may fall under the rubric of "agri-tourism", like hayrides, haunted houses and corn mazes, and may also be included.

Furthermore, future definitions of "agriculture" may include activities that we cannot envision today. Producers must change activities in response to market and other forces. Even if the purpose clause of the easement allows changes from one type of agriculture to another or from forest uses to agriculture, the easement likely lacks the ability to address advances in science due to the prohibition on any development.[96]

Agricultural conservation easements typically include restrictions relating to farm and ranch structures, farm worker housing, rural enterprises and commercial operations, and subdivision.[97] The restrictions on farm and ranch structures may be expressed as impervious surface restrictions.[98] Any of these restrictions could seriously impede adaptive management of the property. For instance, some agricultural activities, like intensive poultry production, involve high percentages of impervious surfaces.

Therefore, the prohibited and permitted uses should not be specifically set out. Instead, the uses should be tied to external standards that are updated regularly or have an external

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[91] *Id.* at *2.
[92] *Id.*
[93] *Id.* (emphasis added).
[94] *Id.*
[95] *Id.*
[96] Mahoney, *supra* note 6, at 758-59.
[97] Renee J. Bouplon and Jane Ellen Hamilton, Drafting Agricultural Conservation Easements, presentation at the 2004 National Land Conservation Conference (Land Trust Rally) in Providence, Rhode Island (on file with author).
[98] *Id.*

body with expertise in agriculture review particular practices for acceptability.[99] Like working forest easements, the easement could require operation pursuant to a management or conservation plan. In addition, land development plans could be included within the easement that establish building envelopes within which farm buildings could be constructed and altered without permission.[100] The easement could allow development outside the envelope if performance standards, addressing issues such as soil quality or agricultural viability, are met.[101]

However, since agriculture encompasses a much broader array of activities than forestry these plans must anticipate a much more diverse set of possibilities. A tension exists between restrictions that land trusts may want to place in easements and the flexibility required to allow adaptive management. Like clearcutting in forestry, some agricultural best management practices are not always acceptable to land trusts and other environmental organizations.

D. Difficulty and Expense of Incorporating Adaptive Management Provisions

Some scholars dismiss concerns about the difficulty and expense of drafting "dynamic" conservation easements to accommodate adaptive management.[102] Greene asserts that the "proliferation of relatively cheap resources—such as publications containing legal advice and sample easement documents and conferences featuring panels of expert practitioners—… should alleviate any concerns that land trusts may have about the difficulty or expense of drafting dynamic conservation easements."[103]

In reality, the more seriously one takes the adaptive management approach, the more difficult the drafting becomes. If an external plan is incorporated by reference, the initial drafting cost and difficulty is reduced. However, updates to the plan and the active management of the property will be costly. If the purpose clause limits the purposes to those that become economically unviable in the future, but require active management, enforcement becomes more difficult. In addition, each conservation easement is negotiated individually, resulting in a lack of uniformity that complicates interpretation, monitoring and enforcement.[104] Adaptive management necessarily entails more specific drafting and planning, exacerbating this issue and further increasing the monitoring and enforcement costs for the easement holder.

A broader concern is the fact that the land which seems best suited for conservation today may well be needed for affordable housing or commercial development in the future.[105] Climate change may cause a species to migrate to a new area or disease may devastate a

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[99] *Id.*
[100] *Id.*
[101] *Id.*
[102] Greene, *supra* note 23, at 908.
[103] *Id.*
[104] JEFF PIDOT, REINVENTING CONSERVATION EASEMENTS (POLICY FOCUS REPORT): A CRITICAL EXAMINATION AND IDEAS FOR REFORM, 8-10 (2005).
[105] Korngold, *supra* note 4, at 1063; Jesse J. Richardson, Jr., *Conservation Easements: Smart Growth or Sprawl Promotion?*, AGRICULTURAL LAW UPDATE 23(9): 4-5, at 4 (Sept. 2006).

forest reducing the protected parcel's habitat values.[106] The purpose clauses for most existing conservation easements undoubtedly prohibit the conversion of the protected land into a dramatically new use based on changing development or environmental needs.

Indeed, conservation easements explicitly seek to prevent pressures to convert land to development purposes. However, conversion of a particular parcel to development may promote not only the public good in general, but environmental interests as well. For example, if a particular parcel is under easement and unable to be developed, the development may occur instead on another, nearby parcel with higher ecosystem values that is not under an easement.[107]

In conclusion, although incorporating adaptive management principles into conservation easements may further adaptive management goals, any measures will be limited. Reference to external plans maximizes flexibility, but increases costs and is ultimately limited by the purposes of the conservation easement.

IV. Amendment and Termination of Conservation Easements

> "Most conservation easements are written to last in perpetuity. Any change to any conservation easement should be approached with great caution and careful scrutiny."[108]

Another method for adapting easements is the use of amendment and termination clauses. This section discusses the various forms of amendment and termination, as well as barriers to accomplishing adaptive management principles through such mechanisms.

A. Amendments and Terminations by Agreement

The Land Trust Alliance sets out seven principles which it believes should guide the amendment of conservation easements.[109] According to the Alliance's guidelines, amendment policies should only be as flexible as necessary and amendments to easements should:

1) Clearly serve the public interest and be consistent with the [holder's] mission;
2) Comply with all applicable laws and regulations;
3) Not raise concerns about the holder's tax-exempt or charitable status;
4) Not result in private inurement or impermissible private benefit;
5) Be consistent with the conservation purpose(s) and intent of the easement;
6) Be consistent with the intent of the donor or grantor of the of the easement and any funding agencies; and,
7) Have a net beneficial or neutral effect on the relevant conservation values

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[106] Julia D. Mahoney, *The Illusion of Perpetuity and the Preservation of Privately Owned Lands*, 44 NAT. RESOURCES J. 573, 589 (2004).
[107] Richardson, *supra* note 105.
[108] LAND TRUST ALLIANCE, AMENDING CONSERVATION EASEMENTS: EVOLVING PRACTICES AND LEGAL PRINCIPLES 9 (2007).
[109] *Id.* at 17.

protected by the easement.[110]

The Land Trust Alliance also urges that the following issues be considered:

- Effect on stewardship and administration of the easement;
- Engagement of stakeholders, other owners or other involved parties;
- Consideration of conflicts of interest;
- Resolution of title issues;
- Concerns about real property tax issues;
- Acquisition of additional expert advice;
- Supplementation of baseline documentation and related cost; and
- Completion of required tax forms.[111]

The guidance recommends a written amendment policy to facilitate application of the important principles.[112] The policy should consider the relevant tax provisions, including private inurement and private benefit prohibitions, state conservation easement enabling statutes, and state law governing charitable organizations.[113]

The guidance fails to mention any consideration of the frustration of the original purpose or any indication of an adaptive management process. The Land Trust Alliance seems to discourage relaxing restrictions on one parcel in exchange for additional or new restrictions on a different parcel.[114] In fact, the Land Trust Alliance has some concerns that such bargains may violate applicable law and lack the necessary court review.[115] For example, IRS regulations provide that the original deduction taken by the donor remains unaffected so long as the termination results from an "unexpected change" that "makes impossible or impractical the continued use of the property for conservation purposes."[116] The termination must occur in a judicial proceeding and the portion of the funds resulting from any subsequent sale or disposition of the property must be allocated to the holder of the easement and must be used in a manner that as closely as possible conforms to the conservation purpose of the original conservation easement.[117]

B. Court Amendments or Terminations

1. Conservation Easements as Charitable Trusts: The Cy Pres Doctrine

The ability of a court to change the terms of a conservation easement or terminate an easement depends in part upon the determination of the true nature of the conservation easements. Two main schools of thought presently exist. The predominant view holds that conservation easements form charitable trusts. Proponents of this view believe that perpetual conservation easements are "special, very powerful land protection tools" and

[110] *Id.*
[111] *Id,* at 18.
[112] *Id.* at 21.
[113] *Id.* at 23-32.
[114] *Id.* at 17.
[115] *Id.*
[116] 26 C.F.R. § 1.170A-14(g)(6)(i) (2007).
[117] *Id.*

that "substantial" amendment or termination should be subject to significant barriers.[118] Others argue that conservation easements are negative covenants, which would give courts much more flexibility in amending easements.

If conservation easements are charitable trusts, the doctrine of cy pres should apply to amendment or termination of conservation easements, at least where the amendment contravenes the purpose of the easement.[119] This position finds support in the Uniform Conservation Easement Act, the Restatement (Third) of Property Servitudes, the Uniform Trust Code, federal tax law, and case law.[120] The doctrine of cy pres states that courts should interpret the provisions of wills to conform to the intent of the testator where literal construction is impossible or impractical.[121] The doctrine, however, constrains the latitude of the courts in making these interpretations. The doctrine requires that the terms of the document be construed to comply with the donor's intent as closely as possible.[122]

The Third Restatement of Property supports this view, providing that private conservation servitudes are not terminated under the changed circumstances doctrine (discussed below in Section IV.B.2.).[123] The Third Restatement of Property holds that if attainment of a particular conservation purpose becomes impracticable, the cy pres doctrine should be applied to modify the conservation easement.[124] Only if no conservation purpose is possible with modification of the easement should the easement be terminated.[125]

If conservation easements are charitable trusts, several factors support the requirement of court approval of substantial amendments or terminations of conservation easements. The significant public investment in conservation easements, the value of development rights extinguished by easements, political and other pressures to modify or terminate easements, increasing scarcity of undeveloped land, and the giving of deference to the intent of the easement donor all militate towards requiring court approval.[126]

2. Conservation Easements as Negative Covenants

Others argue that conservation easements are negative covenants, giving courts much more flexibility in amending easements. Negative covenants, for example, can be amended by courts upon a showing of changed circumstances, relative hardship, and violations of public policy. These doctrines could add some flexibility to perpetual conservation easements.[127]

The doctrine of changed circumstances dictates that a court should not enforce a covenant if enforcement will not bring the intended benefits due to changed circumstances.[128] Changed

[118] McLaughlin, *supra* note 49, at 380.
[119] *Id.* at 382; *see also* Nancy A. McLaughlin, *Conservation Easements: Perpetuity and Beyond*, 34 ECOLOGY L. Q. 673 (2007).
[120] *Id.*
[121] Korngold, *supra* note 4, at 1078.
[122] *Id.*
[123] RESTATEMENT (THIRD) OF PROP.: SERVITUDES § 7.11 (2000).
[124] *Id.* §§ 7.11(1), (2).
[125] *Id.*
[126] McLaughlin, *supra* note 49, at 382.
[127] Korngold, *supra* note 4, at 1076-81.
[128] *Id.* at 1077.

circumstances may apply to a conservation easement if conservation easements are viewed as negative restrictions.[129] For example, suppose a conservation easement states a purpose of protecting endangered species habitat. If, due to global climate change, the species migrates off of the property or becomes extinct, the purpose of the easement could no longer be attained.

The doctrine of relative hardship employs a sort of balancing test, allowing a court to deny an injunction enforcing a covenant, and to instead grant damages where the harm from injunctive relief would be great compared to the benefits.[130] However, unlike the similar balancing test employed in nuisance cases, the balancing does not include a consideration of the public interest.[131] In addition, courts generally enforce covenants through injunctive relief, regardless of whether irreparable harm or monetary loss is shown.[132] Changes to this policy would be required for the doctrine to make conservation easements more adaptable.[133]

Courts generally refuse to enforce covenants that violate public policy.[134] However judicial statements on this issue are few in number and often contained in a portion of the court opinion not necessary to the final decision, or "dicta."[135] Such statements are not binding or authoritative in future cases. Given the favored position of conservation easements in public policy and the fact that courts would likely have to balance competing public interests in such a case,[136] declaring that a conservation easement violates public policy is unlikely. Therefore, the public policy exception likely provides no additional adaptability for conservation easements.

C. Eminent Domain

Eminent domain provides another vehicle by which static conservation easements may be terminated and the property use converted to reflect changed circumstances. Although conservation easements held by government agencies may not be condemned by inferior (or lower) units of government,[137] land subject to privately held easements can be.

The literature is split with respect to the ease by which governments should be able to condemn conservation easement lands. On one hand, the use of eminent domain allows the public to change plans "imposed on [the public] by private organizations."[138] On the other hand, the public invests a great deal in conservation easements and eminent domain may frustrate that investment.[139] In addition, McLaughlin asserts "the danger is … that land

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[129] *Id.*
[130] *Id.*
[131] *Id.* at 1078-79.
[132] *Id.* at 1079.
[133] *Id.*
[134] *Id.* at 1080.
[135] *Id.*
[136] *Id.*
[137] For example, a local government could not condemn land where the state government holds a conservation easement.
[138] Korngold, *supra* note 4, at 1082.
[139] Nancy A. McLaughlin, *Condemning Conservation Easements: Protecting the Public Interest and Investment in Conservation*, 41 U.C. DAVIS L. REV. 1897, 1904-07 (2008).

protected by conservation easements will become the path of least resistance for condemning authorities.[140]

D. State Statutes

Because conservation easements cannot be created under the common law (judge-made law expressed in court decisions), each state must adopt an enabling statute allowing the use of conservation easements. The National Conference of Commissioners on Uniform State Laws adopted the Uniform Conservation Easement Act (UCEA) in 1981. Uniform laws are not binding, but provide models for states that are crafting their own laws. The UCEA has been adopted in some form by 27 states and the District of Columbia.[141] Twenty-two states, most of which adopted enabling statutes before 1981, have enabling authority not based on the UCEA.[142] North Dakota has not enabled the use of conservation easements.[143]

The UCEA addresses amendment and termination in two places. First, § 2(a) states that easements "may be created, conveyed, recorded, assigned, released, modified, terminated, or otherwise altered or affected in the same manner as other easements."[144] Section 3(b) relates to court amendments and provides that the provisions of the act do not "… affect the power of a court to modify or terminate a conservation easement in accordance with the principles of law and equity."[145]

Section 2(a) is amenable to different interpretations.[146] The 2007 Comments to the Model Act support a narrow interpretation.[147] These comments suggest that any amendments should be subject to the cy pres principles.[148] Some scholars, however, interpret § 2(a) much more broadly.[149] This interpretation finds that conservation easements are subject to the same rules for amendment and termination as standard easements. Easements are treated as contracts under the law and amendments and terminations are freely allowed by agreement of the parties.[150]

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[140] McLaughlin, *supra* note 49, at 383.
[141] ROBERT H. LEVIN, LAND TRUST ALLIANCE, A GUIDED TOUR OF CONSERVATION EASEMENT ENABLING STATUTES (2010), *available at* http://www.landtrustalliance.org/policy/cestatutesreportnoappendices.pdf .
[142] *Id.*
[143] *Id.*
[144] UCEA, *supra* note 3, § 2(a).
[145] *Id.*
[146] Levin, *supra* note 141, at 17-18.
[147] *Id.*
[148] *Id.*
[149] *Id.* at 19 (citing C. Timothy Lindstrom, *Conservation Easements, Common Sense and the Charitable Trust Doctrine*, 9 WYO. L. REV. 397, 440 (2009)); Gerald Korngold, *supra* note 4, at 1048; Mary Ann King and Sally K. Fairfax, *Public Accountability and Conservation Easements: Learning from the Uniform Conservation Easement Act Debates*, 46 NAT. RESOURCES J. 65, 104-107 (2006); Adam E. Draper, *Conservation Easements: Now More Than Ever- Overcoming Obstacles to Protect Private Land*, 34 ENVTL. L. 247, 264 (2004); Erin McDaniel, *Property Law: The Uniform Conservation Easement Act: An Attorney's Guide for the Oklahoma Landowner*, 55 OKLAHOMA L. REV. 341, 347 (2002)).
[150] Levin, *supra* note 141, at 19.

Little existing case law interprets state laws on the amendment or termination of conservation easements. One Illinois case involved the amendment of a conservation easement that brought a new 809 square foot area into the easement in exchange for removing an 809 square foot area.[151] The new area was visible from the road, unlike the original area, which arguably meant that the amendment enhanced the public value of the easement. The Illinois enabling statute is silent on amendment and termination. The appellate court found that the easement allowed for amendments, but that the amendments must be consistent with the original easement. Since the original easement prohibited any structures in the removed 809-square foot portion, the court reasoned that the amendment was inconsistent with the original easement and thus invalid.

Even if one manages to amend or terminate a conservation easement, the negotiations and legal hurdles create substantial transaction costs.[152] In addition, easement holders have goals and motivations that do not necessarily coincide with the public good.[153] Present law and policy makes reliance on amendments or termination of conservation easements very unlikely. Even more unlikely is the prospect of incorporating adaptive management principles into amendment and termination procedures and policies.

V. Rolling Easements: Tailoring Conservation Easements for Coastal Areas?

The legal theory supporting the concept of rolling easements is based on the public trust doctrine. The public trust doctrine is a common law doctrine that grants states sovereignty over the beds of navigable water bodies and creates an implied easement over those lands for the benefits of the public.[154] The Texas Supreme Court first coined the term "rolling easement" in upholding the Texas Open Beaches Act (TOBA).[155] Texas law provides that the state owns coastal land seaward of the mean high tide mark.[156] The TOBA provides, in part, that "if the public has acquired a right of use or easement to or over an area … the public shall have the free and unrestricted right of ingress and egress to the larger area extending from the line of mean low tide to the line of vegetation bordering on the Gulf of Mexico."[157] Over the years, Texas courts have found that the public has acquired the right of use to this larger area in some parts of the coast of Texas.[158] The Texas Supreme Court referred to right of the public to use (in this case, access) certain coastal beaches in Texas as a rolling easement because as the sea advances inland, the boundaries of the easement move with the sea, or "roll."

The term "rolling easement" holds several different meanings. More formally, a rolling easement consists of "an arrangement under which property owners have no right or

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[151] Bjork v. Draper, 886 N.E.2d 563 (Ill. App. Ct., 2008).
[152] Mahoney, *supra* note 22, at 777.
[153] *Id.*
[154] James G. Titus, Rising Seas, *Coastal Erosion, and the Takings Clause: How to Save Wetlands and Beaches without Hurting Property Owners*, 57 MD. L. REV. 1279, 1364-68. (1998).
[155] Feinman v. State, 717 S.W.2d 106 (Tex. App. 1986).
[156] Luttes v. State, 159 Tex. 500, 324 S.W.2d 167, 187 (1958).
[157] TEX. NAT. RES. CODE ANN. §§ 61.001 to 61.178.
[158] Seaway Co. v. Att'y Gen., 375 S.W.2d 923, 936-37 (Tex. Civ. App. 1964); Matcha v. Mattox, 711 S.W.2d 95, 101 (Tex. Civ. App. 1986); Feinman v. State, 717 S.W.2d 106, 113 (Tex. App. 1986).

expectation of holding back the sea if their property is threatened."[159] In other words, the term rolling easement has been used to refer to "a broad collection of arrangements under which human activities are required to yield the right of way to naturally migrating shores."[160] Rolling easements allow the property to be used as the landowner sees fit so long as the land remains dry.[161]

Rolling easements may be acquired through eminent domain purchases or by statutory provision.[162] Rolling easements could also be purchased through voluntary transactions or donated. Acquisition of rolling easements should cost substantially less than a purchase of the property by the government as the ocean infringes upon the property due to the uncertainty of sea level rise and the ability of the landowner to use the property productively in the intervening years.[163]

At present, statutory provisions in several states create de facto rolling easements. Maine,[164] Massachusetts,[165] and Rhode Island[166] have statutes prohibiting armoring. These provisions shift the risk of sea level rise to the landowner. A more controversial aspect of the Texas Open Beaches Act is its requirement that structures encroaching on public lands following beach erosion must be removed.[167] South Carolina has also used a rolling easement in a limited context. In 1992, the U.S. Supreme Court remanded a case to the South Carolina Supreme Court to determine whether a taking had occurred with respect to David Lucas' property.[168] The takings claim arose from a required setback for habitable structures on the beach. The South Carolina Coastal Council settled the case by purchasing the property from Mr. Lucas.[169] The Council then sold the property, but imposed a condition that a rolling easement governed the location of construction on the property.[170]

A. Implementing Rolling Easements Through Conservation Easements

Rolling easements could be implemented as a form of conservation easement.[171] The conservation easement could be donated, sold, or required to acquire development or subdivision permissions. The latter method refers to an "exaction."[172] Such easements could prohibit hard coastal armoring and, like the Texas Open Beaches Act, require removal of

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[159] U.S. CLIMATE CHANGE SCIENCE PROGRAM, COASTAL SENSITIVITY TO SEA-LEVEL RISE: A FOCUS ON THE MID-ATLANTIC REGION145 (2009), *available at* http://www.epa.gov/climatechange/effects/coastal/sap4-1.html [hereinafter *Coastal Sensitivity Report*].
[160] Titus, *supra* note 154, at 1313.
[161] Coastal Sensitivity Report, *supra* note 159, at 146-47.
[162] *Id.*
[163] *Id.*
[164] Maine Coastal Sand Dunes Rule, 335 ME. CODE R. §3(b)(1).
[165] 310 MASS. CODE REGS. § 10.30.
[166] *See*, Rhode Island Coastal Resource Management Program §300.7(D) (rev. Dec. 2008), *available at* http://www.crmc.ri.gov/regulations/RICRMP.pdf .
[167] TEX. NAT. RES. CODE ANN. §§ 61.001 - 61.178.
[168] Lucas v. South Carolina Coastal Council, 505 U.S. 1003 (1992).
[169] Titus, *supra* note 154, at 1337.
[170] *Id.*
[171] Coastal Sensitivity Report, *supra* note 159, at 145.
[172] *Id.*

structures that encroach on public lands. The easement document could define the boundary by reference to the distance from the mean high tide line or some other similar measure. Therefore, the easements would "roll" as the ocean moves inward. Acquiring rolling easements in this manner, which would involve compensation to landowners, might be more politically acceptable than imposing similar requirements through statutory provisions such as the Texas Open Beaches Act.

Research supports the position that rolling easements provide economic benefits as compared with armoring of the shoreline, mainly through increased property values.[173] One set of scholars suggests that, particularly given these economic benefits, compensation should be provided to landowners that bear the risk of losing structures due to sea-level rise.[174] Other scholars, however, argue that compensation is not appropriate.[175]

Relying on voluntary donations or sales could, however, prove problematic. Since sea level encroachment is uncertain and likely to occur far into the future, the reduction in property value would have to be discounted to present value. Thus, the easement would likely cause little reduction in value, minimizing purchase prices and tax benefits. Landowners would hold little incentive to voluntarily impose such restrictions on their property.

In addition, governments or land trusts would need to be able to accurately forecast the impacts of sea level rise to efficiently implement the program. Present oceanfront property provides an obvious target for rolling easements. However, some inland properties will also be impacted. Forecasting the timing and location of the impacts would be difficult, hindering full implementation of rolling easements.

Mandatory exactions or eminent domain purchases appear to offer more promise of implementation. However, eminent domain purchases would likely face political opposition. Mandatory exactions, where enabled, may be more feasible. But, home purchasers may resist assuming the risk of sea level rise causing encroachment onto their property. To make even compensated rolling easements politically acceptable, an insurance-type product may need to be developed to compensate landowners who lose their homes due to sea level encroachment. Compensation, however, would neutralize cost savings to the government from the use of rolling easements.

Rolling easements allow adaptive management for coastal easements in at least one respect by moving the boundary of the easement in response to sea level changes. This flexibility offers advantages over present conservation easements, which contain rigid boundaries. However, rolling easements have presently only been implemented through regulatory mandates. Using voluntary incentives to encourage donation or sale of rolling easements is

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[173] *See*, Craig E. Landry, Andrew G. Keeler, and Warren Kriesel, *An Economic Evaluation of Beach Erosion Management Alternatives*, 18 MARINE RES. ECON. 105 (2003); WARREN KRIESEL AND ROBERT FRIEDMAN, COASTAL HAZARDS AND ECONOMIC EXTERNALITY: IMPLICATIONS FOR BEACH MANAGEMENT POLICIES IN THE AMERICAN SOUTHEAST: A HEINZ CENTER DISCUSSION PAPER (2002), *available at* http://www.heinzctr.org/publications/PDF/Externalities.pdf.

[174] Laundry, *supra* note 173, at 121.

[175] Meg Caldwell and Craig Holt Segall, *No Day at the Beach: Sea Level Rise, Ecosystem Loss, and Public Access Along the California Coast*, 34 ECOLOGY L. Q. 533, 576 (2007).

likely to fail for lack of meaningful incentives. Mandating the use of rolling easements through eminent domain or mandatory exactions is also likely to face political opposition.

B. Incorporating "Rolling" Boundaries: Rolling Conservation Easements

Rolling boundaries could be incorporated into standard conservation easements. The most likely situation would be in connection with endangered species habitat or corridors preserved for wildlife migration.[176] For example, a conservation easement protecting endangered species habitat could define the boundaries of the easement by referring to the portion of the property actually used as habitat by the endangered species.

Two obvious issues immediately arise with this scenario. First, the easement would not protect areas that the species may migrate to in the future. Note, however, that existing conservation easements protecting endangered species habitat also fail in this respect. Second, the boundary could roll only to the property line. Unless a similar easement was obtained on adjoining properties, once the species migrated off the subject property, the protections would disappear (just as in existing conservation easements).

These shortfalls could be remedied by incorporating another aspect of rolling easements. A state could, similar to the Texas Open Beaches Act, declare that any endangered species habitat becomes public property and any structures must be removed. Unfortunately, this approach would result in a plethora of lawsuits claiming a taking of private property for public use without just compensation. Unlike coastal areas, which have historically been subject to the public trust doctrine and considered public property, no such doctrine applies to endangered species habitat. Landowners challenging rolling easements for endangered species habitat as unconstitutional takings would likely succeed.

C. Impact of Rolling Easements on Conservation Easements

Incorporation of rolling easement concepts into conservation easements to make "rolling conservation easements" offers some promise. However, implementation of the theory proves problematic in practice. The present use of regulatory mandates and prohibitions may be the only way to implement rolling easements. In addition, the concept is likely not amenable to transfer to situations not involving coastal properties. Although rolling easements for endangered species habitat, for example, remains theoretically possible, implementation would be complex. Rolling conservation easements share many of the flaws of standard conservation easements. The use of different tools may prove more beneficial than more tinkering around the edges of conservation easements.

In fact, rolling easements may negatively impact conservation easements in some cases. For example, suppose a land trust or governmental agency acquires a conservation easement along the coast. As sea level rises and the tides encroach upon the land, the portion of land under conservation easement decreases. With the uncertainty raised by climate change, this migration of the sea landward raises real concerns with respect to the efficacy of obtaining conservation easements in coastal areas. Should public funds be expended to

[176] At least one pair of scholars has suggested a rolling easement approach to preserving animal migration corridors. *See*, Robert L. Fischman and Jeffrey B. Hyman, *The Legal Challenge of Protecting Animal Migrations as Phenomena of Abundance*, 28 VA. ENVTL. L. J. 173, 214 (2010).

obtain a conservation easement on land that will eventually be under water and subject to state ownership? Use of conservation easements in these situations seems inefficient and wasteful.

VI. More Adaptive Alternatives to Conservation Easements

Given the difficulties of incorporating adaptive management principles into perpetual conservation easements, the possibility of other options should be explored. This section discusses less-than-perpetual conservation easements and payments for ecosystem services as two possible options. Both options are currently in place in some form. However, institutional and other factors presently favor perpetual conservation easements.

A. Less-Than-Perpetual Easements

1. Term Easements

Many state enabling statutes allow conservation easements for a term less than perpetuity. Less than perpetual easements are commonly referred to as term easements. However, as the federal income tax benefits only accrue for perpetual easements, the vast majority of conservation easements are perpetual.[177] In addition, most land trusts will only accept perpetual easements.[178]

Term easements are a better fit for the model of adaptive management than perpetual easements. For example, a term easement for a 20-year term could be reevaluated at the end of the period and new management techniques applied. In the alternative, the holder of the easement could decide that the property no longer offers the conservation benefits necessary to justify the easement, and the easement can be terminated without a costly court process.

The major criticism of term easements involves cost.[179] McLaughlin alleges that landowners receive an "economic windfall" with term easements.[180] This concern appears to arise from an objection to the fact that the landowner would receive a payment for conveying the term easement, and at the end of the term, the restrictions no longer apply. However, no economic windfall results from payments for term easements. The fair market value of a 30-year term easement approaches the fair market value of a perpetual easement.[181] The values are similar since benefits received far into the future must be discounted to the present day value. Many existing programs like the Conservation Reserve Program,

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[177] Nancy A. McLaughlin, *Rethinking the Perpetual Nature of Conservation Easements*, 29 HARV. ENVTL. L. REV. 421, 424 n.6 (2005).
[178] *Id.*
[179] COLORADO COALITION OF LAND TRUSTS, TERM EASEMENT WHITE PAPER (2001), *available at* http://www.ctahr.hawaii.edu/awg/downloads/rp_AFT_TermEasements.pdf; McLaughlin, *supra* note 119, at 708-709.
[180] *Id.* at 710.
[181] *Id.* at 675.

Conservation Reserve Enhancement Program, and the Wildlife Habitat Incentive Program are forms of term easements.[182]

2. Term-Terminable and Terminable Conservation Easements

McLaughlin raises two other possible types of term easements: "terminable conservation easements and "term-terminable conservation easements."[183] A terminable conservation easement is a conservation easement that allows the holder of the easement and the landowner to agree to terminate the easement at some time in the future. Terminable conservation easements could be conditionally terminable or freely terminable.[184]

Conditionally terminable conservation easements would contain conditions within the easement that, when met, would allow the holder and the landowner to agree to terminate the easement.[185] For example, the easement could state that if the purposes of the easement become impossible or impractical (the cy pres standard), the easement holder and landowner could agree to terminate the easement without court approval.[186]

A freely terminable conservation easement would contain provisions allowing the easement holder and the landowner to agree to terminate the easement at any time.[187] Presumably, the easement holder would first determine that the easement termination is consistent with the public or charitable mission of the holder.[188] In addition, the holder would presumably receive cash or some other compensation in exchange for agreeing to release the easement. This "horse trading" would give the holder a great deal of discretion.[189] It is important to note, however, that uncertainty arises as to when the termination is consistent with the purpose of the holder.[190]

The ability to easily terminate conservation easements would raise questions as to whether local governments and land trusts should be granted such broad discretion to terminate or modify conservation easements without court intervention; whether non-perpetual easements would "crowd out" other types of land use planning, such as regulation, contrary to the public good; and, whether creation of private markets in development rights would promote the public good.[191] In addition, the terminations and modifications may be so controversial that land trusts and local governments would seek approval from the courts or the state attorney general even without the requirements.[192]

A term-terminable easement differs in some respects from a terminable easement. Like the terminable easement, a term-terminable easement contains no set termination date.

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[182] Jesse J. Richardson, Jr., *Beyond Fairness: What Really Works to Protect Farmland*, 12 DRAKE J. OF AG. L. 163, 180 (2007).
[183] McLaughlin, *supra* note 119, at 708-12.
[184] *Id.* at 710.
[185] *Id.*
[186] *Id.*
[187] *Id.* at 711.
[188] *Id.*
[189] *Id.*
[190] *Id.*
[191] *Id.* at 711-12.
[192] *Id.* at 712.

However, at the end of a set time period, the holder of the easement (perhaps the local government) has the option of renewing the easement or terminating the easement in exchange for a cash payment from the landowner.[193] Term-terminable conservation easements offer more flexibility than perpetual easements and more control and less cost than a term easement.[194] Term-terminable easements may be appropriate, for example, in situations where land at the urban-rural fringe should be conserved for a time, but will be needed for development at some future point.

B. Green Payments and Smart Payments

A green payment is a payment that "efficiently links the production of environmental goods and services with the opportunity to derive an income over and above the cost of producing these goods and services."[195] For example, green payments provide a way to supplement the incomes of farmers while avoiding limitations on commodity subsidies.[196] Such payments are linked to positive externalities resulting from agriculture and not tied to the production of commodities.

A related concept is that of "smart payments." Smart payments would be based on local and regional land use plans and would entail payments to landowners occupying land that should not be developed immediately.[197] A type of payment could be created that would combine green payments and smart payments to compensate landowners for providing environmental services and contributing to smart development patterns.

These types of payments hold several advantages over perpetual conservation easements. Instead of relying on volunteers tempted by tax benefits, these payments could be targeted to the most desirable lands. Payments could be based on contract periods as short as one year, allowing changes based on adaptive management principles. Payments could be based on actual conservation benefits, instead of the federal income characteristics of the recipients. The governmental entity paying the benefits could cap the benefits, necessitating a prioritization of conservation lands.[198]

C. Payments for Ecosystem Services

"Ecosystem services are components of nature, directly enjoyed, consumed, or used to yield human well-being."[199] Ecosystem services have also been defined by describing the functions that natural ecosystems perform that provide critical human life-support services, including:

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[193] *Id.*
[194] *Id.* at 710.
[195] William J. Even, *Green Payments: The Next Generation of U.S. Farm Programs?,* 10 DRAKE J. AG. L. 173, 173 (2005).
[196] *Id.*
[197] Richardson, *supra* note 182, at 181.
[198] *Id.* at 181-82.
[199] Brian C. Steed, *Government Payments for Ecosystem Services: Lessons from Costa Rica*, 23 J. OF LAND USE AND ENVTL. L. 177, 179 (2007) (citing JAMES BOYD AND SPENCER BANZHAF, RESOURCES FOR THE FUTURE, WHAT ARE ECOSYSTEM SERVICES? 8 (2006)).

- Purification of air and water;
- Mitigation of droughts and floods;
- Generation and preservation of soils and renewal of their fertility;
- Detoxification and decomposition of wastes;
- Pollination of crops and natural vegetation;
- Dispersal of seeds, cycling and movement of nutrients;
- Control of the vast majority of potential agricultural pests;
- Maintenance of biodiversity;
- Protection of coastal shores from erosion by waves;
- Protection from the sun's harmful ultraviolet rays;
- Stabilization of the climate;
- Moderation of weather extremes and their impacts; and
- Provision of aesthetic beauty and intellectual stimulation that lift the human spirit.[200]

The concept of payments for ecosystem services (PES) is a relatively well-developed idea that offers an attractive alternative to perpetual conservation easements. PES programs involve voluntary transactions where a governmental or other entity purchases ecosystem services from a landowner.[201] The support for PES programs comes from the ability to save money by paying landowners to provide equivalent services as traditional infrastructure, such as maintenance of water quality, at a lower cost.[202] PES thus constitutes neither a subsidy nor a payment for undefined benefits, as with conservation easements.[203] Instead, PES provides payments for services rendered.[204]

V. Conclusion

Conservation easements "do not fit well with our need for institutions and practices that can adjust with ease to shifting climate and landscape, advances in knowledge, and evolving societal norms."[205] Conservation easements lack the ability to truly incorporate adaptive management because future events or advances in knowledge may show that the fundamental purpose of the easement, to prohibit development, is misguided.[206]

Drafting easements to incorporate adaptive management principles presents daunting challenges. Attempts to amend or terminate existing easement face even bigger hurdles, whether or not court approval proves necessary. Innovative changes to basic conservation easement principles, like rolling easements, offer promise. However, these innovations present additional complexities and limitations in implementation.

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[200] *Id.* at 179 (citing GRETCHEN DAILY, ED., NATURE'S SERVICES: SOCIETAL DEPENDENCE ON NATURAL ECOSYSTEMS (1997)).
[201] *Id.* at 178.
[202] J.B. Ruhl, *Agriculture and Ecosystem Services: Strategies for State and Local Governments*, 17 N.Y.U. ENVTL. L. J. 424, 429 (2008).
[203] *Id.* at 440.
[204] *Id.*
[205] Mahoney, *supra* note 22, at 444-45.
[206] Mahoney, *supra* note 6, at 758.

Instead of mandating or encouraging perpetual easements, regulations should limit the terms of easements. Instead of tinkering around the edges of conservation easements, alternative tools should be examined. Alternatives such as less-than-perpetual easements and payments for ecosystem services not only are more amenable to adaptive management principles, but promote other purported goals of conservation easements more readily.

Less-than-perpetual easements provide managers with more flexibility and a better opportunity to incorporate adaptive management principles than perpetual easements. Cost does, however, present a barrier with respect to term easements. Term-terminable and terminable easements also offer more flexibility, but the transaction costs to terminate those easements would be substantial.

Green payments and smart payments also offer promise. In theory, these payments would allow an adaptive management approach to land conservation. In addition, the payments could be tailored to compensate for conservation benefits received. Present law bases compensation, whether payments or tax benefits, for perpetual easements on development value. Development value has no relationship to conservation value. In addition, the present system of tax incentives fails to prioritize conservation alternatives and relies on volunteers. A green payment or smart payment system could prioritize and target more valuable properties from a conservation perspective. Unfortunately, funding may prove to be a significant barrier to green payments or smart payments.

Payments for ecosystem services provide the most promising alternatives. These programs are already in place in some areas. Research is being conducted to derive market values for various ecosystem services. A PES program would allow taxpayers to know precisely what benefits accrue from payments to landowners. With perpetual conservation easements, the ecosystem services provided by particular easement properties are generally unknown.

Conservation easements are a relatively young legal tool, with the vast majority of easements having come into existence in the past 20 years. Conflicts between conservation easements and new proposed uses are increasing. Abuses and weaknesses have been revealed. Most responses to these developments propose changes to conservation easements to "fix" the problem. However, many suggested fixes prove to be complex as well as uncertain of success. Policymakers should recognize that conservation easements serve as but one tool in a vast toolbox of conservation tools. Other tools, like payments for ecosystem services, should be seriously considered to supplant conservation easements, at least in appropriate circumstances.

What Chance Adaptive Coastal Management For Climate Change? A Legal Dysfunction in Vertical Governance

Patricia Park, Anthony Gallagher, Michael Galley[1]

"Conventional attempts at conquering the climatic future all rely, implicitly or explicitly, upon ideas of control and mastery, whether of the planet, of global governance or of individual and collective behaviour."[2]

"Curtailing climate change must … become the project we put before all others. If we fail in this task, we fail in everything else."[3]

Abstract: Mitigation has been the dominant approach to dealing with climate change to date. Perceived limitations of this approach, however, led Parties to the United Nations Framework Convention on Climate Change (UNFCC) to agree in Bali, 2007 that the alternative approach of adaptation should play a significantly greater role in the future global response, and this is now embedded as one of the post 2012 pillars. There is evidence of adaptation already taking place but this is currently piecemeal in manner. A more strategic approach is therefore needed to ensure that timely and effective adaptation measures are taken, ensuring coherence across different sectors and levels of governance. To this end the European Union produced a White Paper in April 2009, aimed at reducing vulnerability. Similarly, on a national basis many countries are consulting on a range of adaptive instruments, with the UK being no exception and issuing a consultation document on the implementation of the Marine Strategy Framework Directive in October 2009. A major problem, however, is the disconnect between the vertical structure of legal instruments from international conventions, through European Community law, state legislation, and what happens within the coastal communities through local government and agencies. Adaptive management shows up in coastal management plans, regional development plans, and agency guidance documents; yet it appears almost nowhere within codified statutory and regulatory text. The research presented in this article is geographically concerned with exploring the capacity of coastal areas to adapt to change and what legal impediments might hinder such responses. In order to further the research, a case study approach is used with a particular focus on Christchurch Bay, UK, the conclusions from which may be transferred horizontally to other vulnerable areas of the UK coast and beyond.

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[2] Mike Hulme, *The Conquering of Climate: Discourse of Fear and their Dissolution*, THE GEOGRAPHICAL J. 174(1): 5, 5 (2008).

[3] GEORGE MONBIOT, HEAT: HOW TO STOP THE PLANET BURNING 15 (2006).

I. Introduction

There is now irrevocable evidence that our climate is changing. Temperatures have increased globally and observational evidence from all continents and most oceans show that these human-induced temperature changes are having a significant impact on physical and biological systems.[4] However, the problem of uncertainty is one of the major challenges facing those involved in the construction of institutions of international governance. Our knowledge of the social and natural systems that we seek to govern is less dependable than is commonly acknowledged, and our ability to predict the consequences of our interventions into them is more limited than we like to believe.[5] Given that the High Contracting Parties of the United Nations Framework Convention on Climate Change (Framework Convention) agreed at their meeting in Bali to embrace the concept of adaptive management,[6] in this

[4] *See*, Cynthia Rosenzweig et al., *Attributing Physical and Biological Impacts to Anthropocentric Climate Change*, 453 NATURE 353-358 (2008).

[5] Rosie Cooney and Andrew T.F. Lang, *Taking Uncertainty Seriously; Adaptive Governance and International Trade*, 18 EUR. J. INT'L L. 523, 524 (2007).

[6] "The **overall purpose** of the Adaptation, Technology and Science programme (ATS) is to support Parties in developing adaptation strategies and actions to meet their specific needs and concerns relating to adaptation to the adverse effects of climate change and to the impacts of the implementation of response measures. ATS further supports the UNFCCC process in enhancing the development and transfer of technologies, and in improving the methodological and scientific bases for international climate policy and action by Parties, including actions to reduce emissions from deforestation and forest degradation in developing countries (REDD). The programme is responsible for coordinating support for the Subsidiary Body for Scientific and Technological Advice (SBSTA). The basic **mandates** for this programme are contained in several Articles of the Convention, including Article 4 (on commitments), Article 5 (on research and systematic observation), Article 9 (on the SBSTA) and Article 12 (on the communication of information related to implementation). Further basic mandates are contained in Articles of the Kyoto Protocol, including Article 2, paragraph 3, (on implementing policies and measures in such a way as to minimize adverse effects) and Article 3, paragraph 14, (on implementing commitments in such a ways as to minimize adverse impacts). Additional mandates given in decisions and conclusions of the Convention and Kyoto Protocol bodies. Key decisions are stipulated under each programme objective in table 7." UNFCCC,

paper we consider the disconnect between adaptive management in practice and adaptive management in law.

The management theory, known as adaptive management, traces its origins to C.S. Holling's influential book from the late 1970s, *Adaptive Environmental Assessment and Management*.[7] Holling and his fellow researchers found conventional environmental management methods, particularly the environmental impact assessment process under the United States' National Environmental Policy Act, at odds with the emerging model of ecosystem dynamics. They posited that the connections within ecosystems are themselves selective and variable. The outcome of the theory was that because ecosystems are dynamic and can change; anything can happen. Efforts to suppress change are thus not only futile, but also counter-productive. The theory itself has developed further over the years until it came of age in 2007 when the High Contracting Parties to the Framework Convention met at Bali.

Taking at face value the decision at Bali that ecosystem management is the appropriate strategy for climate change, and that adaptive management is the appropriate implementation method for climate change management,[8] the question is how to translate the practice model of adaptive management into law and policy. The idea of "learning by doing" may capture the essence of adaptive management, but does not convey much legal content. Bali laid down a policy statement and this paper will consider whether regional and national legal instruments lend any more precision to the content of adaptive management, and if not, then what barriers this may raise to the actual practice of adaptive management at the local level.

II. The Road to Bali

Climate change emerged onto the international political agenda in 1988, when the UN General Assembly took up the issue for the first time and adopted Resolution 43/53, declaring climate change to be "a common concern of mankind." The debate in the General Assembly came in the wake of the establishment of the Intergovernmental Panel on Climate Change (IPCC) by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP) who jointly set up the panel with a mandate to assess the emerging science of climate change and subject it to intergovernmental scrutiny. The latest set of principles governing its work state that it is to:

WORK PROGRAMME FOR THE SECRETARIAT FOR THE BIENNIUM 2010-2011, FCCC/SBI/2009/2/Add.1, 19 (May 20, 2009) *available at* http://unfccc.int/resource/docs/2009/sbi/eng/02a01.pdf .

[7] ADAPTIVE ENVIRONMENTAL ASSESSMENT AND MANAGEMENT (C.S. Holling ed., 1978). *See, e.g.*, Kai N. Lee and Jody Lawrence, *Restoration under the Northwest Power Act: Adaptive Management: Learning from the Columbia River Basin Fish and Wildlife Program*, 16 ENVTL. L. 431, 442 n.45 (1986) (tracing the term "adaptive management" to Holling's book).

[8] For further discussions, see Kai N. Lee, *Appraising Adaptive Management*, CONSERVATION ECOLOGY 3(2): 3 (1999), *available at* http://www.ecologyandsociety.org/vol3/iss2/art3/; J.B. Ruhl and Robert Fischman, *Adaptive Management and the Courts*, forthcoming in the Minnesota Law Review, Vol. 95, no. 2, pre-print version available at http://ssrn.com/absratct=1542632.

> assess on a comprehensive, objective, open and transparent basis the scientific, technical and socio-economic information relevant to understanding the risk of human-induced climate change, its potential impacts and options for adaptation and mitigation.[9]

Although the IPPC does not carry out the scientific research itself it does conduct a massive review of climate change research which has been published in peer reviewed journals by government bodies, universities, intergovernmental organisations and individual researchers from around the world. Therefore, what the IPCC provides is an objective analysis of all the scientific research in order that policy-makers can make informed decisions.

Although the need for a Framework Convention on Climate Change was agreed in 1990 at the World Summit in Rio de Janeiro it was not until the third Conference of the Parties (COP) when they met in Kyoto that a new regulatory structure was devised which included a number of flexible market mechanisms. The objective of the Convention itself, was the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."[10] This objective is framed in terms of an environmental quality standard inasmuch as it establishes an environmental threshold which Parties must not exceed. However, the threshold that is established (dangerous anthropogenic interference with the climate system) does allow activities which cause such interference up to this point. Article 2 of the Convention goes on to provide additional guidance concerning the timing of any actions to stay within the threshold.[11]

The objective, therefore, has a precautionary emphasis. This preventative focus of the objective also applies to the Kyoto Protocol as the Convention states that "any related instrument" shall share the ultimate objective set out in Article 2. This is also affirmed in paragraph 2 of the Preamble of the Protocol.[12]

A. The Kyoto Protocol 1997

On December 10, 1997, the Parties to the Framework Convention adopted the Kyoto Protocol.[13] The Protocol "sets forth quantitative emission reduction targets for developed (Annex I) countries through 2012, and establishes market-based mechanisms (including emissions trading) for achieving those targets."[14] The principle theme of the new market based mechanisms, as provided for under the Protocol, is the refocusing away from bureaucratic decision-making to basic economic incentives to coordinate more efficient decisions by private actors about how, when, and whether to emit their pollutants.

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[9] Intergovernmental Panel on Climate Change, Principles Governing IPPC Work, para. 2 (1998).
[10] United Nations Framework Convention on Climate Change, art. 2, 31 I.L.M. 849 (July 1992).
[11] *Id.* ("Such a level should be achieved within a timeframe sufficient to allow ecosystems to adapt naturally to climate change…").
[12] Conference of the Parties to the Framework Convention on Climate Change: Kyoto Protocol, 37 I.L.M. 22 (1998).
[13] *Id.*
[14] Daniel Bodansky, *The Copenhagen Climate Change Conference: A Postmortem*, 104 AM. J. INT'L L. 230, 231 (2010).

However, it was not until the High Contracting Parties met in Bali that an enhanced action plan on adaptation was envisaged as part of the Bali Action Plan by the Ad-Hoc Working Group on Long Term Co-operative Action under the Convention (AWG-LCA).

B. The Bali Action Plan

The Bali Action Plan was adopted at COP 13 in Bali, Indonesia in December 2007. It identifies adaptation as one of the key building blocks required for a strengthened future response to climate change to enable the full, effective, and sustained implementation of the Convention through long-term cooperative action, now, up to, and beyond 2012.

At the ill-fated meeting of the High Contracting Parties in Copenhagen in 2009, it was decided to extend the mandate of the AWG-LCA[15] and requested the group to present the outcome of its work to COP 16 when they next meet in Mexico. In addition, the COP took note of the Copenhagen Accord, in which Heads of State, Heads of Government, Ministers, and other Heads of Delegations stressed the need to establish a comprehensive adaptation programme.[16] The signatories agreed that enhanced action and international cooperation on adaptation was urgently required and that developed countries should provide adequate, predictable, and sustainable financial resources, technology, and capacity-building to support the implementation of adaptation action in developing countries, such as Least Developed Countries (LDCs), SIDS, and Africa.[17]

Part IV of the Copenhagen Accord established a Framework for Action on Adaptation (FAA) to climate change, which includes the following elements intended to enhance implementation of effective adaptation action: the development and integration of adaptation actions into national and sectoral planning processes; support for capacity building and risk management approaches; co-operation with international, regional and other organisations and the private sector; enhancing technologies for adaptation; provision of adequate and predictable financial flows, and follow-up on the effectiveness of adaptation actions. The FAA, however, consists entirely of policy proclamations rather than permissory or mandatory requirements.[18]

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[15] UNFCCC, Outcome of the Work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention, Draft decision -/CP.15: Enhanced Action on Adaptation, FCCC/AWGLCA/2009/L.7/Add.1 (Dec. 15, 2009).

[16] UNFCCC, Report of the Conference of the Parties on its fifteenth session, held in Copenhagen from 7 to 19 December 2009, Addendum, Part Two: Action taken by the Conference of the Parties at its fifteenth session, 4 (Mar. 30, 2010).

[17] *Id.* at 6.

[18] Newcomers to the climate regime find tracking adaptation rule development both difficult, because the rules are interspersed in various COP decisions, and perplexing, because an issue as widely supported as adaptation seems to be embroiled in procedural disputes about which Convention article is the relevant basis for action. Although the consideration of Articles 4.8 and 4.9 of the Convention by the COP as a separate agenda item only commenced at COP-4, many fundamental issues relating to adaptation were being addressed by earlier COPs on the basis of other Convention provisions. This is because rule development concerning the adverse impacts of climate change has revolved around making good commitment *already agreed* in the Convention under Articles 4.3 and 4.4. Thus, adaptation issues are discussed as part of the negotiations giving guidance to the Global Environmental Facility (GEF) or other agenda items relating to technology. Adoption of Decision 3/CP.3 by COP-3 added a new dynamic because this Decision mandates the COP to consider actions

III. Theoretical Principles of Adaptive Management

Traditional environmental regulation was based on "command and control," which served to regulate emissions from chimneys and discharge pipes; the disposal of waste in landfill, the transportation of hazardous chemicals, and similar easily-identifiable sources of environmental harm. This system enjoyed a remarkable degree of success with cleaner air and water, less polluted land, and safer roads. However, the future that lies ahead in environmental law is filled with problems of unwieldy dimensions due to intractable causes. Because ecosystems themselves adapt to nature, this confounds the prescriptive regulatory model.

Problems that are foremost to many observers include the invasion of non-native species into ecosystems, the depletion of estuarine resources by fertilizer runoff from countless agricultural operations many miles inland, and climate change, which is irrefutable. Because ecosystems themselves adapt to nature this confounds the prescriptive regulatory model. For these problems there are no available targets for the prescriptions of "command and control," and we have no idea what response the system would have to a particular "command." Problems such as these exhibit the hallmark characteristics of complex adaptive systems and their behaviour emanates from a multitude of diverse, dispersed sources responding to co-evolving interactions, and non-linear cause-and-effect properties.[19]

> These aspects of uncertainty limit the usefulness of forecasting methods for the scientific study and management of regions in transition. Given these limits of understanding, we must focus on learning to live within systems, rather than "control" them. One might argue that it is impossible to deal with such fundamental limits of understanding, and our only reasonable choice is to struggle blindly onward.[20]

Given that the ten scientists who authored the above quote find research in this area so hard to understand, what chance is there for law to bring such aspects under control?[21] Even if legislators provided the regulatory agencies with unlimited powers, those agencies could not "command" away invasive species, or global climate change, and so legislators and regulatory agencies have experimented with many alternatives to the traditional

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related to Articles 4.8 and 4.9 at future sessions as a separate agenda item. An agenda item explicitly addressing developing countries' adaptation-related needs and circumstances has the potential advantage of highlighting a broader range of issues that might not have fitted well into other agenda items. But in the case of adaptation it also brought complications because Decisions 3/CP.3 was critical to getting OPEC countries to withdraw their veto on the adoption of the Kyoto Protocol. This means, however, that progress on adaptation issues has become conditional upon equivalent progress on response measures.

[19] *See generally,* BRIAN GOODWIN, HOW THE LEOPARD CHANGED ITS SPOTS: THE EVOLUTION OF COMPLEXITY (1996).

[20] Brian Walker et al., *Resilience Management in Social-ecological Systems: a Working Hypothesis for a Participatory Approach*, CONSERVATION ECOLOGY 6(1): 14 (2002), *available at* http://www.consecol.org/vol6/iss1/art14/ .

[21] *See, e.g.,* J.B. Ruhl, *Regulation by Adaptive Management – is it Possible?* 7 MINN. J. L. SCI. & TECH. 21 (2005).

prescriptive regulation, including market-based programmes, information-based programmes, and multiparty collaborative planning efforts.[22]

Information based programmes release information about any regulated activities into the hands of the public who may use such information to persuade companies to do what is right and so alter environmentally damaging behaviour. Any multiparty collaborative planning decision-making puts a more diverse set of interests at the negotiating table and so increases the chances of creative, multifaceted regulatory responses. Such negotiated project-specific permits allow for conditions to be tailored to the project rather than a one-size-fits-all approach.

For this "new wave" of regulatory instruments to work well, advantage must be taken of their adaptive qualities and the programmes must themselves be managed adaptively. Such programmes cannot be administered through central decision-making nor implemented through reductionist, linear models of how ecosystems function.[23]

Although it is thirty years since the seminal work of Professor C.S. Holling's and his colleagues' book, *Adaptive Environmental Assessment and Management,*[24] first described the adaptive management methodology, it is still regarded as the "blue-print" and no work on the topic has improved on the core theory. Essentially it is an iterative, incremental decision-making process built around a continuous process of monitoring the effects of decisions and adjusting those decisions accordingly.[25] This is, therefore, a responsive form of decision-making rather than a "front-end" prescriptive decision-making process when the effects of those decisions and other changing conditions are not known; as such adaptive management is more fitting to the needs of future regulatory challenges than is the traditional prescriptive regulation.

The Framework Convention and the Protocol do not contain definitions of adaptation nor related terms such as "adaptive capacity" and "vulnerability." However, various definitions have been refined over time to reflect improved understanding.[26] The IPCC defines adaptation as "adjustments in practices, processes, or structures [which] can moderate or offset the potential for damage or take advantage of opportunities created by a given change in climate."[27]

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[22] *See*, Richard B. Stewart, *Administrative Law in the Twenty-first Century,* 78 N.Y.U. L. REV. 437, 448-453 (2003); *See also*, Patricia Park, *Towards a New Regulatory System for the Atmospheric Environment, in* MOUNTBATTEN YEARBOOK OF LEGAL STUDIES 20-56 (2008).

[23] Ruhl, *supra* note 21, at 27-28.

[24] Hollings, *supra* note 7.

[25] Simon Levin, *Towards a Science of Ecological Management,* CONSERVATION ECOLOGY 3(2):6 (1999), *available at* http://www.ecologyandsociety.org/vol3/iss2/art6/ .

[26] UNFCCC, TECHNICAL PAPER, ADAPTATION TECHNOLOGIES, FCCC/TP/1997/3 (1997).

[27] IPCC, THIRD ASSESSMENT REPORT, CLIMATE CHANGE 2001: WORKING GROUP II: IMPACTS, ADAPTATION AND VULNERABILITY 89 (2001). The definition of adaptation used in previous reports by IPCC did not highlight opportunities created by a changing climate because adaptability was taken to refer "to the degree to which adjustments are possible in practices, processes or structures of systems to projected or actual changes on climate. Adaptation can be spontaneous or planned, and can be carried out in response to or in anticipation of changes in conditions." IPCC, SECOND ASSESSMENT REPORT: CLIMATE CHANGE 1995, WORKING GROUP II:

Because adaptation covers a very broad range of human activities and natural processes, many different typologies have been devised to conceptualise the different types and forms of adaptation. Good examples of planned adaptation concerning human societies include increasing the robustness of infrastructure designs and long-term investments, such as increasing the range of temperature and levels of precipitation that roads and buildings can withstand without failure, as well as devising financial, administrative or legal techniques to transfer risks away from vulnerable communities and/or to provide for collective loss-sharing mechanisms. Planned adaptation concerning ecosystems includes enhancing the adaptability of vulnerable natural systems, such as by the creation of eco-corridors, as well as reversal of trends that increase vulnerability through, for example, the introduction of set-backs for developments in vulnerable areas such as flood plains and coastal zones.

IV. A European Union Adaptation Strategy

Protecting the environment was historically seen as conflicting with other policy priorities, particularly economic development, and it was not until 1981 under the Single European Act that it has been treated as a core competence of the European Union (EU). There are signs of a greater emphasis on the environment, along-side economic and social development, as agreed in the Lisbon Strategy in 2000.[28] Nevertheless, the majority of the EU budget remains focused on sectors such as agriculture and regional development.

Adaptation is being progressed through the European Climate Change Programme II under a dedicated "Impacts and Adaption" working group. Given that the EU has a supranational focus, adaptation implementation is likely in areas that require collaborative action; that is cross-border river basins or cross-sectoral issues. Other areas may require Member States (MS) to develop their own national strategies under the principle of subsidiarity. Finally, there will be areas where neither the EU Commission nor Member States have a lead role but where the promotion of "enabling" conditions could potentially be of value to local adaptation activity.

Whatever the basis it is essential that adaptation is mainstreamed throughout the vertical structure of EU/MS policy and Directives. Such a chance was missed when drafting the European Marine Strategy Framework Directive.[29] This Directive is mandatory and is concerned with the protection and clean-up of marine ecosystems and addresses all human activities that may have an impact on the marine environment. It establishes marine protected areas including areas already identified under the Wild Birds Directive, the Habitats Directive, and NATURA 2000. What this mandatory piece of legislation does not do is mention adaptation nor coastal erosion. However, the EU White Paper "Putting

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IMPACTS, ADAPTATIONS AND MITIGATION OF CLIMATE CHANGE: SCIENTIFIC-TECHNICAL ANALYSES, Preface (1995).

[28]European Parliament, Lisbon European Council 23 and 24 March 2000: Presidency Conclusions (known as the "Lisbon Strategy"), *available at* http://www.europarl.europa.eu/summits/lis1_en.htm .

[29] Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF .

Adaptation & Mitigation into Perspective" has a two-part strategy (1) to reduce GHGs by swift transition to a low carbon economy, which is mitigation, (2) with climate change already happening, societies must adapt to its impacts as a certain amount of climate change is inevitable.[30] Under the White Paper, adaptation measures are to be developed and applied in a cross-cutting approach and include social, economic, and environmental aspects. This is a step in the right direction but a new Directive which may implement these aspirational policies may well be a long way in the future.

V. Adaptive Management: the UK experience

There is nothing new about adaptive decision-making; businesses do it all the time. The question is, however, can administration agencies behave adaptively and survive? Deterrents would include, inter alia, such issues as lack of legal authority. Although the Climate Change Act (2008) in the UK establishes a power enabling the Secretary of State to require public bodies and statutory undertakers[31] to produce reports on the impacts of climate change on them, their policies for adaptation and any progress made; this power is for the requirement of the production of reports on *policies* for adaptation.

These administration agencies operate in an atmosphere in which each decision involves preparation in anticipation of public participation and second-guessing by the judiciary. When decisions on adaptation are made, interest groups and local politicians must let the agency carry that decision out, and the courts must resist the temptation to second-guess the agency decision. Such deterrents create a cultural resistance among many regulatory bodies towards alternative approaches. Given the lack of explicit language authorizing the use of innovative environmental approaches and the uncertainty and complexity of institutional arrangements,[32] it would seem perverse to expect the agencies to embrace adaptive management of their rulemaking and other decisions without first changing the rules.

Under the Aarhus Convention[33] the public not only have a right to environmental information, but one of participation in decision-making. Under Article 2 of the convention the "public" includes one or more natural or legal persons, and "the public concerned" means the "public affected or likely to be affected by, or have an interest in, the environmental decision-making…" This definition is interpreted very widely which provides

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[30] Commission of the European Communities, Green Paper from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions – Adapting to climate change in Europe – options for EU action {SEC(2007) 849}, COM/2007/0354 final (June 29, 2007), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0354:FIN:EN:PDF .

[31] Statutory undertakers are bodies with a statutory responsibility for delivering services such as energy and water.

[32] *See*, THE ROYAL COMMISSION ON ENVIRONMENTAL POLLUTION, ADAPTING INSTITUTIONS TO CLIMATE CHANGE (2010), *available at* http://www.rcep.org.uk/reports/28-adaptation/documents/adaptation_final_report.pdf .

[33] Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention), June 25, 1998, 38 I.L.M. 517 (1999). Both the UK and the EU are signatories to the Aarhus Convention.

an opportunity for anyone to comment prior to a final decision or challenge the decision once it has been made.

In the UK, this has led to not only locals with an interest, but "flying interest groups"[34] challenging planning decisions in particular. However, equity would suggest the importance to involve stakeholders, particularly local communities, in developing adaptation responses and ensuring that issues of equity (distributional and governance) are taken into consideration. The difficulties of ensuring equitable responses to climate change adaptation arise because the impacts of climate change are not likely to be felt evenly across society as some people are likely to be more vulnerable than others.[35]

The full effects of climate change are likely to be felt most intensely by future generations with the possibility of decisions made now creating problems or costs for future generations. This raises difficult questions about intergenerational equity. Policy decisions are usually based on an analysis of their cost-effectiveness, or cost-benefit analysis, but it can be hard to quantify benefits in the case of adaptation to climate change, due to uncertainties about the nature and extent of future change.

The key issue facing all stakeholders is that of decision-making under conditions of such uncertainty. Precise predictions of the future are not possible; therefore, grappling with adaptation to climate change requires decision-makers to work out ways to make sense of a dynamic and uncertain system, which is influenced by many variables. Such uncertainty can relate to insufficient knowledge, difficulty of measurement, or lack of understanding. There is also evidence of cases where competition with other goals will hamper adaptation.[36]

Different values and interests can lead to very different ways of framing a problem. For instance, the protected areas of tomorrow for nature conservation will look very different from the protected areas of today, and society will have to make difficult decisions about how we manage such protected areas. Such decisions are likely to be shaped by personal values and interests, and a willingness, or otherwise, to accept change. This would lead some organizations and individuals to focus on short-term decisions and outcomes which may be in conflict with what is required for building long-term adaptive capacity.

The main constraint on decision-making in adaptation is the absence of, not only legal authority, but also enabling mechanisms. The planning system in the UK has limited scope

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[34] "Flying Interest Groups" are, sometimes large, organised groups of people who come from outside the area in question, but make it their job to support any local group who are against decisions made by a local Agency/authority.

[35] As part of its study, the Royal Commission, *supra* note 32, made an evidence-gathering visit to Happisburgh on the Norfolk coast, where they heard that the community felt they did not have sufficient opportunity to take part in framing issues or solutions. The Royal Commission was concerned that questions of equity, including the loss of property values when coastlines are no longer protected from erosion, remain unaddressed. Similar issues arose when considering resources available to compensate for loss of habitat when contrasted with those available to compensate vulnerable human communities.

[36] For example, the proposal to create floodplain woodland in the Lever catchment to help manage flood risk in Ripon did not proceed in the end because financial incentives proved insufficient and a greater return could be achieved by using the land in ways other than as floodplain woodland.

to promote new schemes or to enable adaptation of the existing built environment, although it can encourage particular forms of development through development planning. Although many people are aware that climate change exists and could be a problem, they are not likely to take action in the near future to do anything about it unless they feel imminently threatened by the consequences. Clearly, public engagement in areas such as coastal erosion, flood protection, and nature conservation is very important. This is because a decision-making process which is perceived to be open and fair by those potentially affected can go a long way to enhancing tolerance, or even acceptance, of the outcomes. It is this input of local knowledge and understanding which can contribute to the mitigating problems of taking decisions under conditions of uncertainty and complexity.

Effective decision-making on adaptation will require the participation of the right number of people with the right skills and training, and sufficient financial resources, in conjunction with a range of stakeholders sharing responsibility for ensuring that, for example, flood defences work properly. Inevitably the burdens of climate change will be unevenly distributed, with people living in flood or coastal zones likely to feel the most dire effects of climate change. Although the provision of flood and coastal defences in the UK is a discretionary power rather than a duty and is determined by cost-benefit analysis, Treasury rules do allow for consideration of social well-being.

VI. Coastal Protection and Flood Defence in the UK: A Case for Adaptive Management?

A. The Legislative Framework

In England, the laws governing the defence of coastal land against the sea have a long history, which has profoundly influenced their content, and has resulted in the creation of two separate statutory regimes. One deals with flood defence,[37] and is concerned with the protection of low-lying land against temporary inundation, and applies to inland as well as tidal waters. The other deals with coast protection and involves the prevention of permanent erosion and encroachment by the sea.[38] Because flood defence is closely related to land drainage, it is historically associated with agricultural land.[39] In contrast, coast protection is more concerned with the urban coast, and was introduced as an emergency measure to repair defences of coastal towns that had been neglected during the Second World War. The common factor between both regimes is that they were designed to keep the sea at bay by artificial means, and they did not originally contemplate the possibility of managed realignment. The United Kingdom is also required to adopt legislation to implement the EC Floods Directive.[40]

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[37] The flood defence is administered by the Environment Agency under the Environment Act 1995 and the Water Resources Act 1991.

[38] Coastal protection is carried out by district or unitary councils under the Coast Protection Act 1949.

[39] The origins of this body of law may be traced back to the appointment of commissioners of sewers in the thirteenth century.

[40] Directive 2007/60/EC of the European Parliament and Council of 23 October 2007 on the assessment and management of flood risks (Floods Directive), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:288:0027:0034:EN:PDF .

Although most of the legal rules governing flood defence and coast protection in the UK are now contained in legislation, there are also some relevant principles of common law, which have been applied by judges in decided cases, and reflect established custom. The majority of these principles have arisen in England because of the particular vulnerability of low-lying coastal land to the effects of flooding and erosion there. However, the common law is equally applicable to Wales and Northern Ireland, and has also influenced the development of Scottish Law.

In 1609, Lord Chief Justice Coke stated that the Crown had a common law duty, as part of the Royal Prerogative, to defend the coast against the inroads of the sea. This was described as analogous to the Crown's responsibility to protect the borders of the realm against military invasion:

> by the common law … the King ought of right to save and defend his realm, as well against the sea, as against the enemies, that it should not be drowned or wasted…[41]

Nevertheless, this obligation cannot be enforced in the courts, since the Crown is not legally accountable for the exercise of its prerogative unless legislation declares it to be so.[42] On the other hand, the Crown's theoretical responsibility can be invoked to prevent others from behaving in ways that would increase the risk of flooding erosion. Thus, a landowner normally must not act so as to expose another's property to invasion by the sea, since this would cause a breach of the Crown's duty.[43] Furthermore, a statutory body which assumes that duty may take action to prevent such interference.[44] However, if a person builds sea defences to protect his own property, he will not be liable if they increase the risk to neighboring land, provided that he acts reasonably.[45]

As a general rule, private owners of coastal land are not required to keep the sea at bay, and those who erect defences for their own protection have no obligation to maintain them for the benefit of others.[46] However, in 2000 the Court of Appeal held in the case of *Holbeck Hall Hotel Ltd v Scarborough Borough Council*[47] that an occupier owes a measured duty of care under the English common law of nuisance, to take reasonable steps to prevent a risk of damage to neighboring property due to the collapse of his own land through a cliff fall.

B. Statutory Compensation

Under the Water Resources Act 1991, the Environment Agency would be liable to compensate coastal landowners if they take *active,* as opposed to *passive,* measures to implement managed realignment. However, the amount of damages will be the difference

[41] Isle of Ely Case, (1609) 77 Eng. Rep. 1139.
[42] Although a statutory body to which the Crown expressly delegates its duty may be required to discharge it, this will depend on the wording of the grant. *See,* Lyme Regis Corporation v Henley (1834), 6 Eng. Rep. 1180.
[43] Attorney General v Tomline, [1880] 14 Chancery Division 58.
[44] Canvey Island Commissioners v Preedy, [1922] 1 Chancery 179.
[45] R v Commissioners of Sewers for Pagham, (1828) 108 Eng. Rep. 1075.
[46] Hudson v Taybor, (1877) 2 Queens Bench Division 290.
[47] Holbeck Hall Hotel Ltd v Scarborough Borough Council, [2000] Queen's Bench 836.

between the value of the land before and after the works,[48] and will be assessed by the Lands Tribunal in the event of a dispute.

C. Human Rights and Coastal Erosion

Where coastal land is owned or occupied by private individuals, the risk of flooding or erosion may also raise questions under the Human Rights Act 1998, which transposed the European Convention for the Protection of Human Rights and Fundamental Freedoms (1950) into UK domestic law. All the statutory bodies and local councils that are involved with flood defence or coast protection are public authorities for the purposes of the Human Rights Act, and if they unlawfully interfere with Convention rights when performing their public functions, the victims may seek redress in a national court or tribunal.

The Convention itself does not expressly refer to flooding or erosion but Article 8 declares the right to respect for private family life, which includes a person's home; and Article 1 of the First Protocol expresses an entitlement to the peaceful enjoyment of possessions, which can include land and buildings.[49] Notwithstanding these two provisions they are both subject to qualifications and the public interest may justify the deprivation of property or restrictions on its use.

D. Nature Conservation and Human Rights

Recent appeals concerning private sea defences in an English site of specific scientific interest (SSSI) illustrate the complex considerations that must be balanced when coast protection, nature conservation, and human rights issues are involved. In 2005, Natural England[50] extended the Pakfield to Easton Bavents SSSI in Suffolk to include an area on the landward side of a cliff, upon which there were private houses. The scientific interest of the site arose from the prehistoric fossils that were progressively exposed by erosion of the cliff face. The listed operations that required Natural England's consent included the "erection, maintenance, and repair of sea defences or coast protection works."

A landowner was subsequently refused permission by Natural England to construct a sea defence by depositing material on the beach in front of the cliff in order to slow the process of erosion. However, his appeal under the Wildlife and Countryside Act 1981 was allowed in March 2008 by the Secretary of State who agreed with an inspector that preventing the appellant from protecting his home would constitute an unnecessary and disproportionate interference with human rights.[51]

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[48] Farmer Giles v Wessex Water Authority, [1990] Estates Gazette 102.

[49] The text of the Convention and Convention protocols is available at http://conventions.coe.int/Treaty/Commun/ListeTraites.asp?MA=3&CM=7&CL=ENG .

[50] Natural England is an independent public body whose purpose is to protect and improve England's natural environment and encourage people to enjoy and get involved in their surroundings. Natural England, About Us, http://www.naturalengland.org.uk/about_us/default.aspx (last visited July 23, 2010).

[51] *See*, Refusal of Natural England to permit maintenance of sacrificed sea defences: North Sea, Easton Lane, Easton Bavents, Suffolk: Packfield to Easton Bavents Site of Special Scientific Interest: Report to the Secretary of State for Environment, Food and Rural Affairs, Report NSAP37, Planning Inspectorate, Bristol, 19 February 2008.

However, another landowner challenged the designation of the same SSSI in the High Court.[52] He claimed that promoting erosion was not a legitimate purpose for declaring an SSSI, since it involved destruction rather than conservation. The High Court ruled that conservation was a dynamic concept which may include allowing natural processes to take their course.

E. The Policy of Managed Realignment

The task of implementing managed realignment is complicated by the traditional approach of current legislation, which assumes that flood defence and coast protection are concerned with the exclusion rather than the admission of the sea. However, the discretionary character of the powers of flood defence and coast protection authorities means that they generally have no legal obligation to preserve particular areas of coastal lane, and consequently they should be able to abandon existing structures. On the other hand, since mere abandonment leading to uncontrolled failure may have unpredictable consequences, managed realignment is more likely to involve active intervention, which also needs to be compatible with statutory functions.

Public bodies operating under statute are only entitled to do what their legislation either expressly or impliedly authorizes, and they may be subject to judicial review if they exceed their powers. Their conduct must also not be wholly unreasonable, in the sense that no reasonable authority would have behaved in the same way, and this test will apply not only to positive actions but also to omissions. Thus, an unjustifiable decision to abandon sea defences may still be challenged in the courts as an abuse of discretion.

Managed realignment is a pragmatic policy to address a serious consequence of rising sea levels by adaptive management. Whether it is capable of achieving its objectives will depend not only on its practicability, but also on the legality of the procedures and techniques employed. The case studies below highlight some of the problems and possible solutions.

VII. Climate Change and Coastal Management in the UK

In the UK, management of the coast, at least indirectly, has been in evolution since engineers first started to build "hard" physical structures such as sea walls, harbours, ports, and coastal resorts, thereby interfering with natural coastal processes.[53] Such interference with the coast, particularly during the nineteenth century and a large part of the twentieth was considered the norm, since the environment was viewed as a resource to be exploited and over which control could be exercised. The implications, however, of this "control" were not fully understood at the time. Since then, greater scientific knowledge has resulted in a deeper understanding of the dynamic nature of the environment and with respect to the coast, shed light on a number of serious issues such as coastal erosion,

[52] R (on the application of Boggis) v Natural England, [2008] EWHC 2954 (Admin).

[53] *See generally*, Peter W. French, *The Changing Nature of, and Approaches to, UK Coastal Management at the Start of the Twenty-First Century*, THE GEOGRAPHICAL JOURNAL, 170(3): 116-125 (2004).

pollution, and habitat loss. All of these, to varying degrees, have resulted from this intervention; and, all are part of the complex set of hazards associated with climate change.

Understanding the nature of climate change is of course fundamental to effective management, with predictions based on the development of climate change scenarios; where such scenarios are defined as coherent, internally consistent, and plausible descriptions of a possible future state of the climate. It is not a forecast; rather, it is one alternative image of how the future can unfold. In this regard, a set of scenarios is often adopted to reflect the range of uncertainty involved in the projections. As a result there is an accumulating body of evidence pointing to the continued rise in average near-surface sea temperatures, increasing sea level, and both greater surface run-off and multiplicity of storm events. Despite an evident uncertainty at the confidence that can be placed in downscaled predictions, there is a consensus that the UK's coastline is at increasing risk from one of a number of associated complex hazards. For example, Figure 1 shows the vulnerability of coastal areas to flooding in England and Wales.

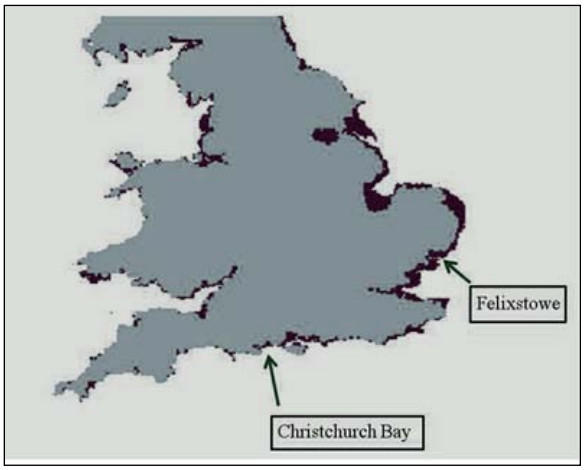

Fig. 1. Coastal vulnerability to flooding in England and Wales.

The UK Climate Impact Programme predicts that over half a million people directly employed in marine activities and more than £150 billion of assets are estimated to be at risk from coastal flooding.[54] This is of particular significance to the South and East coasts of England, which are subject to a sinking coastline due to isostatic compensation as a result of the retreat of ice from the northern part of the British Isles at the end of the last ice age; as well as the effects of climate change, with its predicted rising tides and winter storms.

Historically, coastal flooding and erosion have been the subject of a piecemeal approach to shoreline management with individual "hard engineering" schemes built with a view to protecting defined and often short stretches of coastline. There are currently over 2000 km of such measures, built up over the centuries, but particularly during the time between the

[54] UK Climate Projections, Online Marine & Coastal Projections Report (June 2009), Introduction & Overview, http://ukclimateprojections.defra.gov.uk/content/view/1833/500/ (last visited July 26, 2010).

two World Wars, and the period immediately thereafter. Indeed, following 1945, with the UK involved in rationing food supplies, attitudes were very much focused both on land reclamation for agricultural purposes and on a "hold the line" approach whereby coastal areas were to be protected against another "enemy" – the Sea. As such, the Coast Protection Act 1949 was passed as a means of entrusting "coastal protection authorities," i.e. local Maritime District Councils, with the power and ability to access central government funding to carry out protection measures seen as being appropriate. The Act was the spur for a host of coastal engineering works, with many funded with little concern for viability and cost; and with many ending abruptly at administrative boundaries. In 1985, an element of control was introduced with the requirement for decisions to be based on the application of a traditional cost-benefit analysis approach, though still this was without reference to the effects of measures upon adjacent coastal areas.

Enshrined in the Coast Protection Act 1949 is also a distinction between schemes designed to avoid the threat of coastal flood (sea defence) and those designed to eliminate or control coastal erosion (coastal protection). Whilst the latter is still under the auspices of the Maritime District Councils, since the Water Resources Act 1991 the responsibility for flood defence now belongs to the Environment Agency. The "Regulator," as the agency is known, has a duty to reduce flood hazards through the development of protection measures, the introduction of flood warning systems, and the ability to enable bylaws for flood defence purposes. These functions are carried out by regional flood defence committees who are charged with acting against seawater or tidal water inundation in their area. In addition, with some private landlords, including the Ministry of Defence, also developing coastal defences and protection, this resulted in a complex, site specific and fragmented approach to shoreline management, which did not view the coastal environment as the dynamic and interdependent zone of land and sea that science was proving it to be. Instead the different organizations considered their own particular issues, with generally poor communication links between them. This approach did not therefore reflect the greater understanding of the coastal environment and hence led overall to ineffective management solutions.[55]

The continued existence of fixed physical defences in a situation whereby sea levels are rising has lead to loss of coastal habitats, and in particular intertidal saltmarsh and mudflat areas as a result of a condition known as "coastal squeeze." However, many of these defences are now coming to the end of their effective lives, and the sustainability of maintaining such structures is being questioned.[56]

Part of the greater scientific understanding of the coastal environment came in the form of advances in coastal processes, and the interrelationship between sediment dynamics and coastal geomorphology. For example, it was seen that the best form of coastal defence was in fact a beach since the availability and transportation of sediment would use the energy of tides and waves, and hence reduce the likelihood of coastal erosion. Hard physical

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[55] *See generally*, RHODA BALLINGER, JANE TAUSSIK, AND JONATHAN POTTS, MANAGING COASTAL RISK: MAKING THE SHARED COASTAL RESPONSIBILITY WORK, COASTAL PLANNING AND SHORELINE MANAGEMENT: A REVIEW OF LEGISLATION AND GUIDANCE, A REPORT TO THE LOCAL GOVERNMENT ASSOCIATION'S SPECIAL INTEREST GROUP ON COASTAL ISSUES (2002).

[56] *See*, R.K. TURNER, ET AL., COASTAL MANAGEMENT IN THE 21ST CENTURY: COPING STRATEGIES FOR VULNERABILITY REDUCTION, CSERGE Working Paper ECM 06-04 (2004).

structures such as groynes or sea walls only reduced and restricted the availability of sediment and hence enhanced certain localised erosion.

A further key discovery was that of the "sediment cell" (or littoral cell); defined as "a length of coastline … where interruption to the movement of sand or shingle should not have a significant effect on adjacent sediment cells."[57] In other words, each sediment cell could effectively be viewed as a discrete management unit in which coastal processes could be used so as to better protect the wider coastal area in question. This led to an acknowledgement that coastal processes and shoreline management should be affected through greater strategic and integrated thinking.

The need for greater strategic management and integration in coastal management more widely was acknowledged on an international level at the United Nations Conference on the Environment and Development held in Rio de Janeiro in 1992. In particular, Chapter 17 of Agenda 21 dealt specifically with oceans and coastlines and committed signatories to the "integrated management and sustainable development of coastal areas."[58] At a national UK level, the House of Commons Environment Select Committee (HOCESC) supported this, and highlighted the inadequacy of the existing UK framework in a 1992 report entitled "Coastal Zone Protection and Planning."[59] In this report, the Committee made a number of recommendations, the most salient being that the coast should be treated as one unit; in other words that coastal management should be integrated. The report further stated that in order to achieve this there should be a rationalisation of the existing legislation and organisational responsibilities to come under one strategic national coastal management plan; and that, in order to operate this plan, there should be a national coastal zone management unit established. In addition, to further this, there should also be an extension of the terrestrial planning system out to 12 nautical miles, enabling integration of spatial planning across both land and sea, thereby removing the problem of the coastal boundary.[60]

The UK Government accepted some of the recommendations made by the Committee, but not all. For example, despite acknowledging the need for greater integration along the coast, the government historically insisted that radical organisational surgery was unnecessary and that the existing framework was appropriate to deliver the desired integration.[61] In accepting the elements of integrated coastal management but rejecting a statutory framework, the Government thus paved the way for the development of the voluntary approach clearly evident today. Indeed, the last decade has seen a proliferation of non-statutory plans and voluntary networks that have emerged in order to better co-ordinate the activities of vested stakeholder interests in contested coastal environments. Table

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[57] Dorset Coast Forum, Shoreline Management Plans, http://www.dorsetforyou.com/index.jsp?articleid=21145 (last visited July 26, 2010).

[58] U.N. Conference on Environment and Development (1992), Earth Summit: Agenda 21, http://www.un.org/esa/dsd/agenda21/ (last visited July 26, 2010).

[59] HOUSE OF COMMONS ENVIRONMENT SELECT COMMITTEE, COASTAL ZONE PROTECTION AND PLANNING, SECOND REPORT (1992).

[60] *Id.*

[61] DEPARTMENT OF THE ENVIRONMENT, COASTAL ZONE PROTECTION AND PLANNING: THE GOVERNMENT'S RESPONSE TO THE SECOND REPORT FROM THE HOUSE OF COMMONS SELECT COMMITTEE ON THE ENVIRONMENT, Cm 2011 (1992).

1 identifies the variety of such voluntary coastal groups operating at different geographic scales and with different purposes in the UK.

Table 1: Typology of Voluntary Coastal Groups in the UK[62]

Type	Purpose	Example(s)
International	To network and lobby on an international level	The EU Coastal Union
National: Government	To enhance coordination at a national level	Welsh Coastal and Maritime Partnership
National: Non-governmental	National networking and training	CoastNET
Regional	Facilitate information on a regional scale	Arc Manche
Issue or Sector-based	Resource management; facilitate information sharing, problem identification; policy formulation and implementation.	Standing Conference on Problems Associated with the Coastline (SCOPAC)
Local multi sector groups (Coastal Partnerships and similar Fora)	Sustainable multiple resource management: Facilitate information sharing; problem identification; policy formulation and implementation	Dorset Coastal Forum; Exe Estuary Management Partnership; Solent Forum

With regard to the management of coastal processes, an example of a voluntary group working towards a more integrated approach is that of the Standing Conference on Problems Associated with the Coastline.[63] This stakeholder group is an example of an issue-based group which includes local authorities, members of the public, and other relevant organisations concerned with holistically managing the processes of the south coast of England, between Portland Bill, Dorset and Selsey Bill, West Sussex. A schematic of the principal organisations involved in the environmental management of coastal areas in England and Wales (at present), and the position of the voluntary coastal groups, is shown in Figure 2.

[62] Adapted from Table 2 (Voluntary Coastal Groups operating in the UK) in Stephen Fletcher, *Stakeholder Representation and the Democratic Basis of Coastal Partnerships in the UK*, MARINE POLICY 27(3): 229–240, 231 (2003).

[63] Standing Conference on Problems Associated with the Coastline, http://www.scopac.org.uk/ (last visited July 26, 2010).

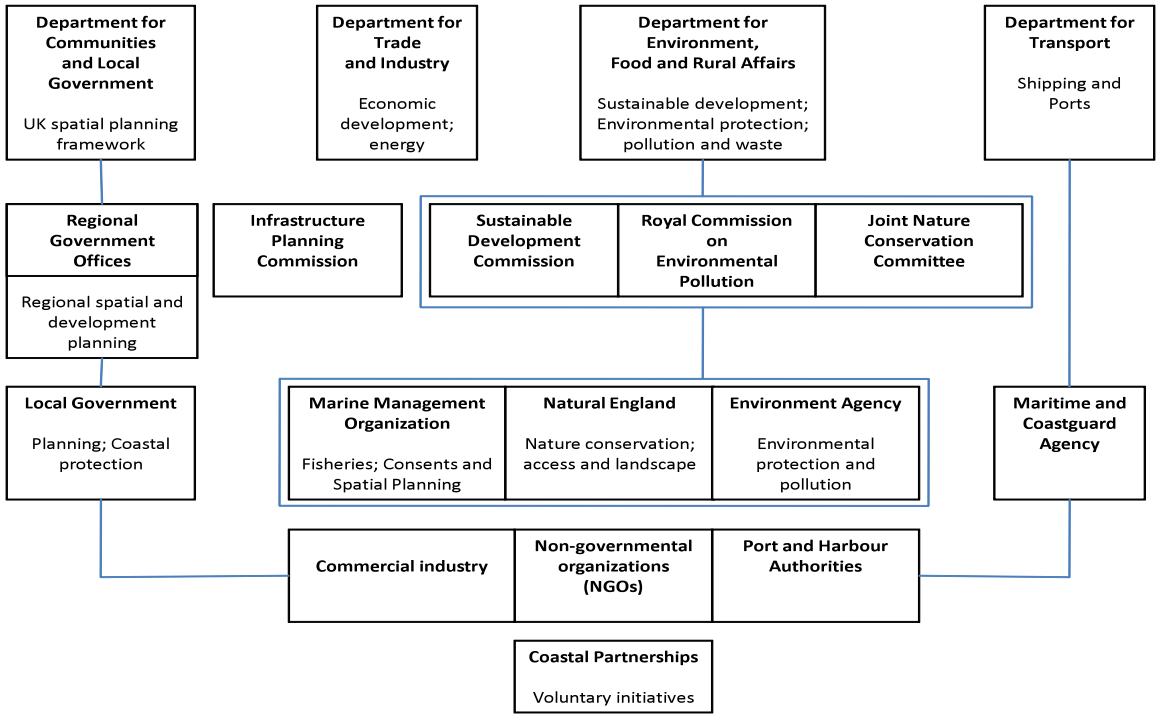

Fig. 2: The principal organisations involved in the environmental management of coastal areas in England and Wales. Graphic courtesy of Anthony Gallagher.

Evidence of the UK Government encouraging integrated initiatives can also be seen in several of its subsequent planning and policy statements. For example, the Planning Policy Guidance note on Coastal Planning (PPG20), issued in 1992, outlined the Government's commitment to encourage cooperative working, stakeholder participation, and the role of voluntary networks in coastal planning.[64] In addition, and more specifically, the Ministry for Agriculture, Fisheries and Food (MAFF) published non-statutory guidance relating to coastal defences, entitled "Shoreline Management Plans: A Guide for Coast Defence Authorities" in 1995.[65] This outlined a more strategic and co-ordinated approach by which the Maritime District Councils were "encouraged" to manage coastal processes. This new framework involved the production of Shoreline Management Plans (SMPs) aimed at developing sustainable coastal defence policies based on sediment cells and sub-cells. Table 2 identifies a typology of UK coastal plans, including SMPs, which are non-statutory documents, offering guidance strategically and for the long-term, which are delivered through "Regional Coastal Groups" with a Lead Authority in the shape of the Maritime District Councils. The development of SMPs has lead to enhanced cooperative working between engineers, planners, and other relevant organisations and stakeholders with the view to choosing one of four policy options for each coastal area. Those options are:

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[64] DEPARTMENT OF THE ENVIRONMENT, PLANNING POLICY GUIDANCE NOTE 20: COASTAL PLANNING (1992).

[65] MINISTRY OF AGRICULTURE, FISHERIES AND FOOD, SHORELINE MANAGEMENT PLANS: A GUIDE FOR COAST DEFENCE AUTHORITIES (1995).

- Hold the line
- Managed realignment
- Non-active intervention
- Advance the line

The traditional "hold the line" approach relates of course to preserving the coastline as it is, whereas "advance the line" relates to pushing it further into the sea. "Managed realignment" is a response to greater understanding with respect to coastal sediment processes and involves selecting non-high value locations, whereby breaches are made in existing defences[66] and intertidal saltmarshes and mudflats are allowed to form to create natural, "soft" sea defences against flooding and erosion.[67] This increases the availability of sediment, saves money on the maintenance costs of the respective coastal defences and also of course has the added advantage of enabling the recreation of endangered habitats.

[66] Examples include Tollesbury, Essex, Brabcaster, Norfolk, Alkborough Flats and Thorngumbald on either side of the Humber, and Abbots Hall Farm on the Blackwater estuary, near Colchester. These sites were chosen specifically by nature conservation organisations as a means of protecting shrinking saltmarshes and saline lagoons, promoting employment through nature tourism, and maintaining a form of sea defence at a lower cost than traditional hard measures. They also help the government observe its obligation to provide for lost habitats under the provisions of the Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora) and the Wild Birds Directive (Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds).

[67] Turner, *supra* note 56.

Table 2: Typology of UK Coastal Plans[68]

Management Plan	Prepared By:	Primary Purpose	Reason for Plan Production	Statutory Basis	Geographic Coverage	Degree of Integration	Characteristics
Development plans	Planning Authorities	Land use planning	Legislative requirement	Town and Country Planning Act 1990	Regional and local	Subject specific	Public participation required in plan production; and area coverage to Mean Low Water
SAC Management Schemes	Management group of relevant authorities	Habitat and species conservation	Legislative requirement	EU Habitats and Species Directive 1992	Local	Subject specific	Participatory in nature; and, comprehensive use of scientific data
Heritage Coast Management Plans	Local Authorities and Countryside Commission	Public access and recreation	Response to management problems and funding availability	Non-statutory	Regional and local	Subject specific	Focuses on practical conservation and access
Shoreline Management Plans	Coastal Defence Authorities	Coastal defence	Response to management problems and funding availability	Non-statutory	Regional and local	Subject specific	Plans inform the statutory planning process
Estuary Management Plans	Management group of relevant authorities and other stakeholders	Sustainable estuary resource management	Response to management problems and funding availability	Non-statutory	Regional and local (dependent upon estuary size)	Integration (intended)	Plans prompted by English Nature's Estuaries Initiative (1993)

Both the Environment Agency and Local Authorities have statutory discretion to decide whether or not to protect particular areas, but must act "reasonably." Their powers to carry out any engineering works must therefore have a positive benefit for the protection of coastal land, which implies that an active intervention for the purpose of managed retreat may need to be combined with some protective work in order to be lawful. Passive inaction that allows defences to be breached naturally, or through "non-active intervention," would therefore appear legitimate and whilst there is no entitlement to expose third party land to risk of flooding by active interference with sea defences, there is also no obligation to maintain the existing works. In addition, whilst there is a statutory obligation to compensate landowners for the depreciation in the value of their land, there is also no liability if damage is the result of natural processes.

Having been negotiated, consulted and introduced, SMPs are intended to be reviewed at nominal five yearly intervals so as to enable their evaluation; to incorporate any new research or changes of national policy; and hence to improve coordination, and foster better guidance and administrative mechanisms. The first tranche of SMPs have thus undergone such a period of review with one of the principal conclusions being that whilst SMPs represent a marked improvement on the previous approaches, offering both participation and integration, they are still not fully integrated into the statutory planning system. Furthermore, since decision-making is still based on cost-benefit analysis, which estimates a value for private property but which fails to calculate the value of sediment lost through

[68] Table adapted from ROBERT KAY AND JAQUELINE ALDER, COASTAL PLANNING AND MANAGEMENT (1999)

erosion or gained through accretion, it fails to fully account for the functionality and value of the environment. Other criticisms have also pointed to logistical aspects such as inappropriate SMP boundaries in relation to coastal processes and a failure to generate or use new scientific information, largely as a result of limited funding.

There are therefore a number of areas where management can be improved. With respect to adaptation, one of the key criticisms has been that there is no compensation mechanism available for the loss of buildings or land due to coastal change, or to enable the funding of transitions relating to coastal change. As such there would appear to be a failure with respect to enabling social justice and it can be concluded therefore that there is no explicit or embedded adaptation strategy in the SMP approach and hence that there is still a need for further management thinking.

VIII. Policy Developments Relating to Coastal Management and Adaptation

From a policy perspective, progress in the integration of coastal management has been made continually since 1992, both nationally and internationally. The principal driver in this has been the European Union, whose current strategy has major implications for UK coastal management. Following the EU Demonstration Programme on Integrated Management in Coastal Zones in Europe, which reviewed coastal management in 35 local and regional projects around the Member States between 1997 and 1999, the EC Communication to the European Council and Parliament stated that "an integrated, participative territorial approach is required to ensure that the management of Europe's coastal zones is environmentally and economically sustainable, as well as socially equitable and cohesive."[69] It went on to state that the integrated management of the coastal zone requires strategic, coordinated and concerted action at the local and regional level, guided and supported by an appropriate framework at the national level. To this end, a European Parliament and Council Recommendation concerning the implementation of Integrated Coastal Zone Management (ICZM) in Europe was adopted on May 30, 2002.[70] The Recommendation required individual Members to initiate a national stocktaking exercise in order to analyse the actors, laws, and institutions that influenced the planning and management of their coastal zones. The Recommendation further required that this stock-taker should form the basis from which a national ICZM implementation strategy should be produced.

For the UK, the stocktaking exercise was carried out by the Atkins Consulting Group and completed in 2004[71] and the ICZM Strategy for England was published in 2008. This strategy has as its core a series of principles of which adaptive management is one, although as a strategy this does not provide any detail as to what adaptive management might involve.

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[69] European Commission, Communication from the Commission to the Council and the European Parliament on Integrated Coastal Zone Management: A Strategy for Europe, COM/2000/547 (2000), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2000:0547:FIN:EN:PDF .

[70] Council of the European Union, Recommendation of the European Parliament and of the Council of 30 May 2002 concerning the implementation of Integrated Coastal Zone Management in Europe, 2002/413/EC (2002), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:148:0024:0027:EN:PDF .

[71] ATKINS CONSULTING GROUP, ICZM IN THE UK: A STOCKTAKE (2004).

At the same time as the national ICZM strategies were being developed, the idea of marine spatial planning (MSP) was also being progressed both in Europe, through the development of the Integrated Maritime Policy, and in the UK, through the commitment to introduce new primary legislation in the form of the Marine and Coastal Access Act which received Royal Assent in November 2009. This Act is aimed at delivering a more holistic, ecosystem-based approach to "marine stewardship" through a package of new initiatives including the introduction of a range of measures and a new Marine Management Organization in order to implement and regulate a three-dimensional planning system for UK waters. This represents a significant development in terms of the management of the marine environment but includes no specific powers with respect to coastal adaptation.

With respect to Europe, there are two key planks of marine and maritime policy; namely the Marine Strategy Framework Directive[72] and the EC Communication on An Integrated Maritime Policy for the European Union.[73] The former is concerned with implementing an ecosystem-based approach to European waters in order to enable "good environmental status" for those waters by 2021; whereas the latter is concerned with establishing good governance and integrated coordination of the EU maritime sector in order to achieve sustainable development. This includes such diverse interests as the "quality of life" in coastal regions, tourism, shipping and ports, and energy production and states that given the interaction of coastal and maritime issues across the land-sea interface, an overall EU maritime policy would have a major stake in the success of ICZM. Consideration should therefore be given to an EU-wide mechanism for comparative analysis and an exchange of best practice. The Policy also goes on to reference the ecosystem-based approach and identifies maritime spatial planning (as opposed to marine spatial planning) as an action area. Whereas the Marine Strategy Directive makes no explicit reference to adapting to climate change, the Integrated Maritime Policy Communication does state the need for supporting research in mitigating and adapting to climate change in maritime and coastal zones. However, this represents only a broad indication of intent rather than any specific action.

A more specific EU action has been the EC Floods Directive[74] which requires Member States to carry out flood risk assessments and prepare flood hazard maps. This was transposed into UK law by the Flood Risk Regulations 2009[75] and since supported by the Planning Policy Statement 25: Development and Flood Risk[76] published in March 2010 and the Flood and Water Management Act which received Royal Assent on 8 April 2010.[77] Flood

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[72] Marine Strategy Framework Directive, *supra* note 29.

[73] Commission of the European Communities, Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions of 10 October 2007 on an Integrated Maritime Policy for the European Union, COM/2007/575 (2007), *available at* http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0575:FIN:EN:PDF .

[74] Floods Directive, *supra* note 40.

[75] Statutory Instruments 2009 No. 3042, *available at* http://www.opsi.gov.uk/si/si2009/uksi_20093042_en_1 .

[76] Communities and Local Government, Planning Policy Statement 25: Development and Flood Risk, http://www.communities.gov.uk/publications/planningandbuilding/pps25floodrisk (last visited July 26, 2010).

[77] The text of the Flood and Water Management Act 2010 and additional information is available at http://www.defra.gov.uk/environment/flooding/policy/fwmb/ .

risk assessment maps will of course help provide improved information for SMPs and raise awareness, thereby contributing towards a more adaptive management approach, and hence they represent an essential component of any toolkit for adaptation.

Another significant development in relation to coastal change has been the Department of Environment, Food, and Rural Affairs' publication of "Adapting to Coastal Change: Developing a Policy Framework" in March 2010,[78] which is seen as a "staging post" in supporting coastal communities adaptation to coastal change. As part of this, a Coastal Change Fund has been made available which includes the provision of a coastal erosion assistance fund to help cover some of the transition costs incurred by homeowners who experience the total loss of a home due to coastal erosion. This proposes grant aid available to local authorities to cover baseline level of assistance with the immediate demolition and moving requirements of affected homeowners, though it still does not cover the value or alter the long standing policy not to pay compensation. The basis for this policy is that no one has the statutory right to flood or erosion protection; therefore, where protection cannot be provided, the homeowner cannot claim compensation. The homeowner does however have the right to be engaged in the process of appraising whether the investment to reduce the risk is justified and can make a claim for compensation on this basis.

The Coastal Change Fund is also available to fund specific projects known as Coastal Pathfinders, of which 15 coastal pathfinders were announced in December 2009. The purpose of these being to enable partnerships to be developed which operate innovative approaches to planning and managing change; with the intention of improving the understanding of how coastal communities can adapt to coastal change, including the costs and benefits involved. These then can provide practical lessons and examples that can be shared with other practitioners, particularly on community adaptation planning and engagement and delivery of adaptive solutions. This then represents a learning programme aimed at developing and sharing best practice.

IX. Case Studies

This section will consider two examples of adaptive planning for flood control, the first covering the experiences and problems related to the Christchurch Bay area on the South coast, and the second examining the use of the UK Climate Impact Programme's (UKCIP) Adaptive Wizard as a proactive planning tool by the port of Felixstowe on the East coast. It is not within the scope of this paper, however, to consider the actual extent of the climate change outcomes as determined by UKCIP.

A. Christchurch Bay

A study of future coastal defence management in Christchurch Bay was undertaken by members of the Tyndall Centre for Climate Change in 2004.[79] It details the physical

[78] The document and additional information is available at http://www.defra.gov.uk/environment/flooding/documents/manage/coastalchange-policyframework.pdf .

[79] Roger Few, Katrina Brown, and Emma L. Tompkins, *Climate Change and Coastal Management Decisions: Insights from Christchurch Bay, UK,* COASTAL MANAGEMENT 35(2): 255-270 (2007) [hereinafter *Insights from Christchurch Bay*].

problems from weather variability, both on a historical and an anticipated basis, as well as a consideration of problems related to the planning process posed by the interaction of planning authorities, from a local to a national level.

Christchurch Bay spans some 18 km of the Dorset-Hampshire coast, stretching from the high headlands of Hengistbury Head at the western end, to the narrow spit of shingle of Hurst Spit in the East. Much of the coast and its hinterland is largely urbanised, the stretch between Barton and Christchurch forming a continuous residential belt; further eastward, the land is dedicated more to agriculture and conservation and recreational use.[80] As well as being an attractive area to live and retire, the area attracts large numbers of summer visitors, putting heavy pressure on the natural character of the coastline. The natural processes of the sea, the weather, and groundwater movements also impact upon the coast and on human activity there.[81]

The geology consists mainly of sedimentary tertiary sands and gravels, which offer little resistance to weathering. At Barton on Sea, situated approximately midway along the bay, exposed clay forms an underlay to permeable sands, where percolating rainwater results in slip plains and mass rotational land slumps. Prevailing South Westerlies produce a longshore drift from west to east, with the beaches at the more sheltered western end consisting of finer beach material than the coarser materials at the eastern end, where rock and gravel produces beaches that are predominantly shingle. Figure 3 illustrates the bay and its sedimentation transport patterns.

[80] ROGER FEW, KATRINA BROWN, AND EMMA L. TOMPKINS, TYNDALL CENTRE FOR CLIMATE CHANGE RESEARCH, SCALING ADAPTATION: CLIMATE CHANGE RESPONSE AND COASTAL MANAGEMENT IN THE UK (2004).

[81] *See generally*, NEW FOREST DISTRICT COUNCIL, NEW FOREST DISTRICT COUNCIL MANAGEMENT PLAN (2003).

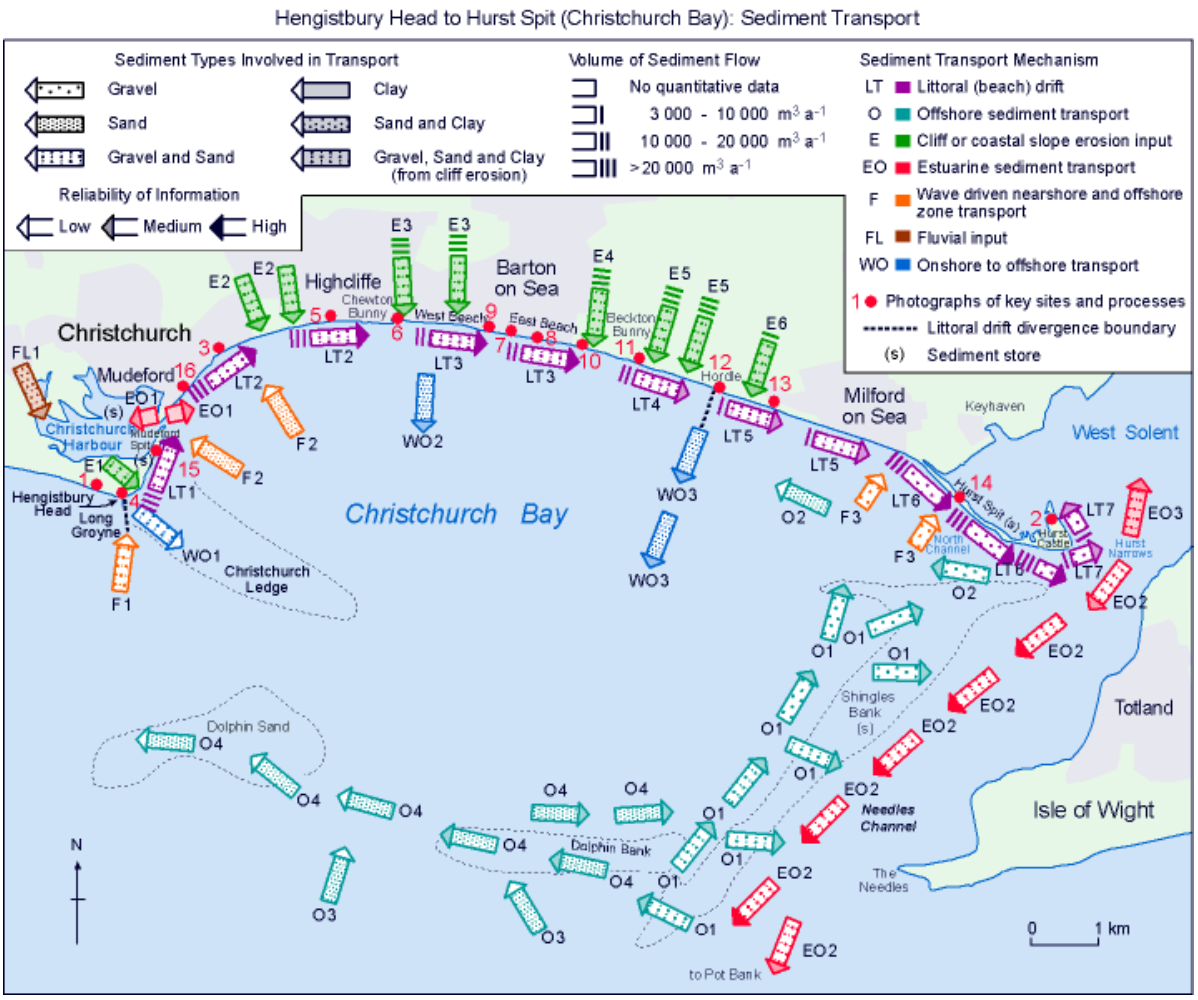

Fig. 3. Christchurch Bay. Graphic courtesy of Royal Haskoning UK Ltd.

Climate change predictions indicate an increase in the rate of erosion caused by the rising sea level (as well as some possible changes to wave direction and sedimentation patterns). However, it is the expectation of higher winter rainfall and storms that is considered more likely to exacerbate coastal changes through groundwater seepage and cliff falls at Barton, whilst flooding of the harbour at Christchurch may result from higher river flow and extreme high tides. It is the potential changes in both the terrestrial and marine environments that add to the uncertainties of climate change in terms of extent of the possible success of any mitigating/adaptive action. Much of the coastline already has a mix of both hard sea defences such as sea walls, and soft sea defences, such as beach replenishment; these in turn appear to have resulted in effects on protection measures and changes to sedimentation patterns further along the coast. Whilst slowing the rate of erosion, the construction of hard coastal defences can reduce the amount of material naturally generated to replace the beaches and spits. In addition, the construction of sea walls prohibits the natural movement inland of coastal habitats of mudflats and saltmarshes which results from rises in sea level, a process known as "coastal squeeze."

These valuable inter-tidal habitats, which absorb energy and water, are consequently lost by drowning.[82]

Christchurch Harbour itself is formed by the lower valleys of the Stour and Avon rivers and is connected to the sea by a narrow channel. The harbour is largely protected from the sea by the Mudeford Sandbank, which lies in the lee of Hengistbury Head. Since the construction of the Long Groyne in 1938, the sandbank has lost much beach material, threatening a breach to the harbour and the likelihood of extensive flooding. A range of groynes to seaward was subsequently constructed by the Christchurch Borough Council to counter this threat. Along the northern shore of the harbour and in the low-lying areas around Christchurch, hundreds of properties are potentially at risk from tidal and/or riverine flooding.[83]

Erosion from the high wave energy along the bay, especially at Barton on Sea, has caused the cliffs to recede to within a very short distance from a number of cliff-top buildings. Erosion rates averaging more than 1.5 metres per year have been experienced in some of the undefended stretches of the coast. Barton is at long-term risk from coastal recession and subsequent further loss of housing, roads, etc., since funding for long-term protection is not guaranteed; meanwhile cliff erosion continues, even without the added complication of climate change. Exposure of important fossil beds by erosion of the cliffs at Barton is deemed to be of importance for geologists; it is therefore considered necessary to allow erosion to take place, albeit at a reduced rate. Over the years, a range of measures have been tried around the Barton area, beginning with wooden groynes and rock revetments. A new concept of siphoning off drainage water was introduced to reduce the rate of cliff recession.

Further east, the soft cliffs at New Milton are designated a geological SSSI and for that reason, are unprotected, but the need to reduce the rate of erosion and improve the aesthetics of the beach has been recognised. At Milford on Sea, strong coastal protection measures have been constructed to protect the suburban development, with a concrete sea wall and rock revetments offering protection from both erosion and flooding. Timber groynes control longshore movement of shingle and inhibit its transport eastwards.

At the Easternmost end of the bay lays Hurst Spit, a 2.5 km shingle bank originally formed by natural processes, with Hurst Castle at the seaward end. The Spit provides an important coastal defence for the Western Solent and a designated area of saltmarsh to the North. In the 1940s, the construction of coastal protection works further westward in the bay disrupted the natural flow of shingle; a breach in 1996 required the construction of a rock breakwater and rock revetment and regular replenishment by recycled shingle. The area contains two Special Areas of Conservation and a Ramsar site.[84] A permanent breach could lead to erosion of the marshes and mudflats behind the Spit and extensive inland flooding.

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[82] Turner, *supra* note 56.

[83] Insights from Christchurch Bay, *supra* note 79.

[84] ROYAL HASKONING UK LTD., POOLE AND CHRISTCHURCH BAY SHORELINE MANAGEMENT PLAN REVIEW SUB-CELL 5F, SECTION 4, POLICY DEVELOPMENT ZONE 1, 4.2.3 (2009).

The eastern section of the bay lies within the New Forest District Council (NFDC) in Hampshire; the western section lies mainly within the Borough of Christchurch in Dorset, with Hengistbury Head falling within the Borough of Bournemouth. Coastal defence from the effects of flooding and coastal erosion has long been a major problem in the bay and most of the defensive works have so far been carried out by the local authorities and the Environment Agency, but these defences have not always been constructed to a unified or coordinated pattern. It was only in the late 1990s that the first SMP for the area was instigated on an integrated basis for the period of some 50 years ahead.

The first generation SMP focused mainly on historical defence measures and SMP1 sought to replace earlier piecemeal plans to address a series of cliff collapses in the 1990s and 2001 with more sustainable options. A timescale of 100 years is now employed by the NFDC and modern computer technology and GIS techniques allow a much closer monitoring of events. This extended timescale, together with the uncertainties of effects on particular sites add to the difficulties of an effective programme of adaptation. As well as meeting government requirements for coastal management and coordinating proposals for activities of all the various agencies involved, the SMP also intended to promote public understanding of the special qualities and problems of the coast.[85] The proposals from SMP1 for some of the various sections of the coast are shown in Table 3. The second generation SMP, due to be completed by the end of 2010, focuses more on natural processes, which may result in some shoreline defences being abandoned. SMPs may now formally include the option of "no defence"[86] or "managed retreat" whereby expenditure on coastal defences cannot be justified or would have unacceptable impacts elsewhere.[87]

Table 3. Proposals from Shoreline Management Plan 1[88]

Unit	Location	Policy
CBY7	Hurst Spit	Hold the Line, short and long term.
CBY6	Milford-on-Sea to Hordle Cliff	Hold the Line, short and long term.
CBY5	Hordle Cliff to Barton Common	Do Nothing short term, Selective Retreat long term.
CBY4	Barton Common to Cliff House Hotel	Hold the Line, short and long term.
CBY3	Marine Drive West, Barton	Retreat short term, Hold the Line long term.
	Naish Holiday Village	Retreat short term, Do Nothing long term.
	Chewton Bunny	Retreat short term, Hold the Line long term.
CBY2	Chewton Bunny to Mudeford Bank	Selectively Hold the Line, short and long term. Undefended sections possibly retreat long term
CHB 4,5	Mudeford Quay and Town	Hold the Line, short and long term
CBY1	Hengistbury East	Retreat
	Mudeford Spit	Hold the Line

[85] New Forest District Council Management Plan, *supra* note 81.
[86] Parliamentary Office of Science and Technology, Postnote: Coastal Management, no. 342 (Oct. 2009) *available at* http://www.parliament.uk/documents/post/postpn342.pdf .
[87] New Forest District Council Management Plan, *supra* note 81.
[88] Adapted from Royal Haskoning, *supra* note 84, at 4.2.14.

SMPs, however, are non-statuary, high-level documents. A summary of the proposed preferred options for the various sections of the bay are shown in Figure 4, which highlights the local and specific nature of the plans for each section of the bay. Key values for the shoreline as contained in the second SMP include, but are not limited to:

- Protecting the economic viability and heritage values of Christchurch;
- Reducing flood risk to Christchurch and Mudeford;
- Maintaining the communities of Barton and Milford;
- Managing risk to properties due to flooding and erosion where sustainable;
- Maintaining geological exposure of cliff line;
- Maintaining the dynamic coastal zone and its capacity to change
- Reducing reliance on defences.

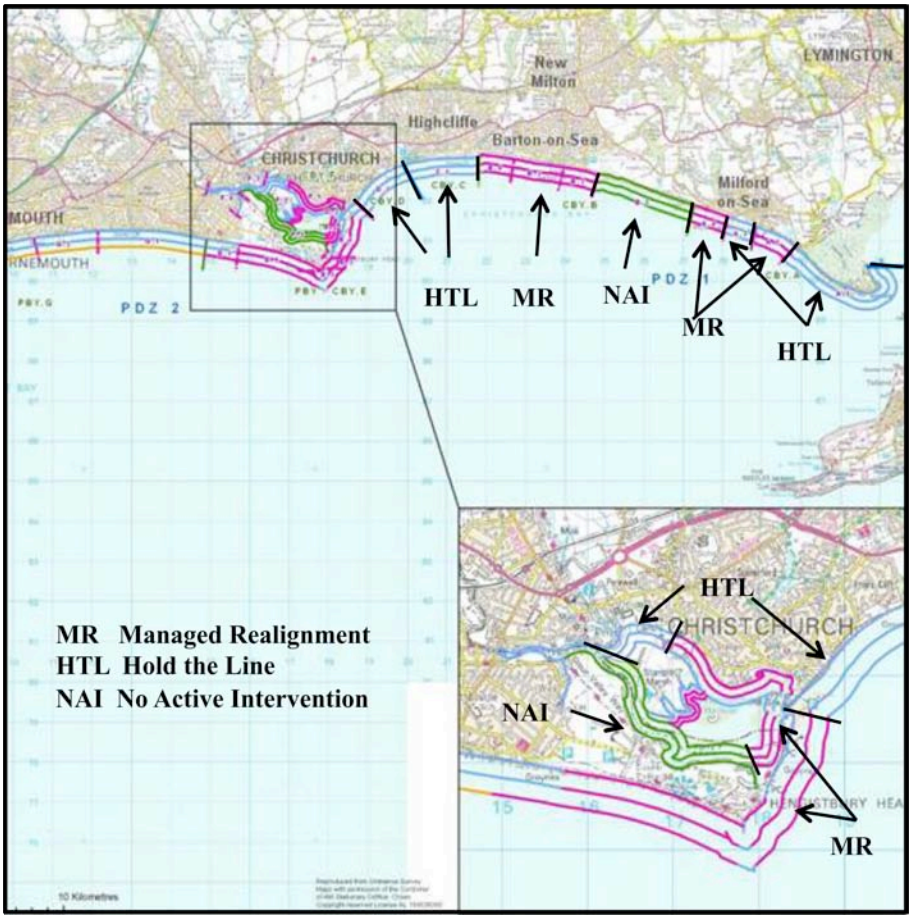

Fig. 4. Proposed Policy, Shoreline Management Plan 2. Graphic courtesy of Royal Haskoning UK Ltd.

At Christchurch Harbour, the general plan is to "Hold the Line" for important development areas around the harbour, whilst allowing natural adaptation of habitats and to maintain without enhancing the sea wall in front of Mudeford (unless longer term sea rises dictate otherwise). Natural development of the estuary habitat should be allowed.

The plan for Barton is one of long-term adjustment, protecting the eastern sea front and improving the stability of the coastal slope, whilst accepting further cliff recession. To the west of the town, adaptation would allow the loss of property whilst reducing the rate of loss through establishing some degree of control over existing defences and drainage. As well as the deliberate breaching of certain established sea defences to establish new buffer zones of marshland, managed retreat may also include a measure of long-term management of the rate of cliff erosion by soft engineering techniques such as beach recharge, slowing without stopping completely the rate of cliff toe erosion.[89]

To the east, the seafront at Milford is to be managed by retaining the beach and drawing forward the natural realignment by means of offshore structures or, should funding not be available, realigning the defence line backwards to maintain an area of beach, whilst at the same time, allowing some increased exposure of the designated geology. Hurst Spit is to be maintained by holding the line at Hurst Castle and maintaining the eastern end of the rock revetment and groyne.

B. The Port of Felixstowe – UKCIP Adaptive Wizard

The UK Climate Impact Programme's (UKCIP) Adaptive Wizard is a process devised to help organisations to assess their vulnerability to current climate and future climate change, identify their options for addressing their key climate risks, and helping them to develop a climate change adaptation strategy that will ultimately lead to the formulation of decisions or strategies that will facilitate the development of a climate change strategy.[90] Through a series of five steps (see Figure 5), members of an organisation, working together as a small group, can be directed to source, assemble, and analyse information and assumptions pertinent to the organisation through a series of tasks and questions[91] that can assist in the development of a plan. This, in turn, should be subject to review as further information and understanding is generated. Rather than supply data and answers, the tool is intended more to lead the user to supply data that is pertinent to his organisation and lead him to solutions relevant to his own situation. A case study illustrated by UKCIP covers the use of the Adaptation Wizard by the Port of Felixstowe; some of the basic findings are cited below.

[89] New Forest District Council Management Plan, *supra* note 81.
[90] UK Climate Impacts Programme, The UKCIP Adaptation Wizard V 2.0 (2008), www.ukcip.org.uk/wizard (last visited July 26, 2010).
[91] For a full set of tasks and questions, *see* UKCIP Adaptation Wizard, Download Notepad, http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=92&Itemid=219 .

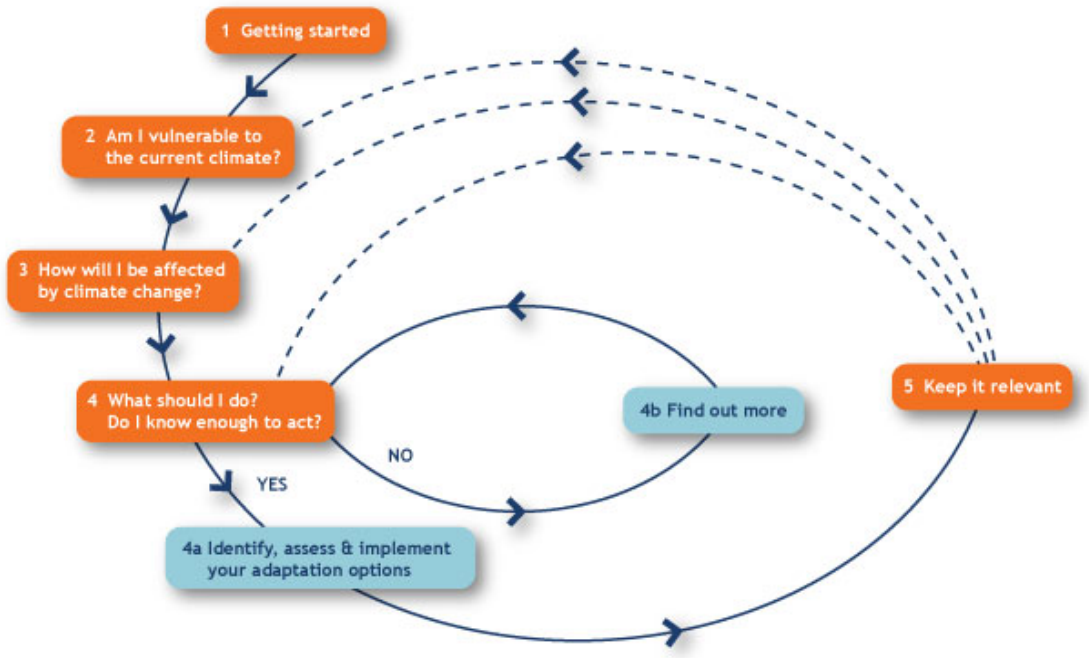

Fig. 5. *The UKCIP Adaptation Wizard* v 2.0. © UKCIP (2008). Graphic courtesy of UK Climate Impacts Programme.

The port of Felixstowe is located on the east coast of England, a coastline which is already sensitive to current risks from the vagaries of the weather. Possible new and increased risks from climate change may result in increase to both the coast's and the port's vulnerability. In 2009, the port worked with UKCIP to employ the first three steps of the Adaptation Wizard to formulate a high level assessment of the likely impacts and adaptive measures deemed necessary by the port to maintain its operational status and position as the UK's largest container port.[92] This proactive work has also enabled the port to respond promptly to the new requirements for formal reporting of their assessments and adaptation plans to the Secretary of State.[93]

As an illustration, the following are extracts from the Felixstowe exercise, which covered some of the tasks in the first three steps of the Wizard. Step 1 – Getting started – is intended to define objectives and the resources needed, and identify those who are to be involved and the management requirements necessary to achieve the outcomes.[94] Within Step 1, Task 1.5 sought to identify the actual problems that need to be assessed, namely the possible adverse climate change effects. Felixstowe listed these to include power outages resulting from damage to the distribution system; changes to sedimentation patterns,

[92] UKCIP, Adaptation Wizard: Case study, http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=686&Itemid=560 (last visited July 26, 2010) [hereinafter *Felixstowe Case Study*].
[93] Climate Change Act 2008, 2008 Chapter 27, s.59, *available at* http://www.opsi.gov.uk/acts/acts2008/ukpga_20080027_en_6#pt4-pb1-l1g59 .
[94] UKCIP, Adaptation Wizard: Step 1 Getting Started, http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=49&Itemid=200 (last visited July 26, 2010).

navigation routes and the potential need for dredging; losses and stoppages resulting from adverse weather; and the knock-on effect that disruption to inland distribution might have on the port.[95]

More frequent port closures could impair the port's competitiveness. On the other hand, early measures taken to address the risks might actually enhance the port's competitive advantage. The objectives of Task 1.5b involved exploring the anticipated robustness of the infrastructure in the face of climate change. These included recommendations for improving the resilience to change, objectively assessing the need for adaptation, and the raising of awareness within the organisation.[96]

Task 1.10a sought to identify anticipated barriers to adaptation and identified the need for better evidence and confidence in climate change in order to facilitate commercial arguments for investing in climate change adaptation. Issues highlighted included the incompatibility of long-term investment decisions with the normal time frame of current business decisions and the limited pressure to make such investments compared to the day-to-day investments required to meet more normal business risks.[97]

Step 3 of the process examined how the port may be affected by climate change.[98] By means of a workshop, Task 3.2 sought to define the anticipated climate impacts on the port in the six generic business areas of markets, logistics, premises, people, finance, and processes. Amongst the threats to the port that were identified were the long term nature of investment (the design-in concept usually being somewhat cheaper than retrofitting); the risk of quays being overtopped by higher sea levels, with the associated adverse impacts on equipment operation and hence productivity; the problem posed by wind, which is a factor that can have a significant effect on container handling.[99] The process also afforded an opportunity to ensure that provisions to adapt to climate change can be incorporated into developments in a way that is cost effective and establishing better processes for monitoring changes will allow better collaboration with manufacturers to produce more robust equipment. It also identified the possible need for less dredging as a result of higher sea levels.

The above allowed a listing of priorities requiring adaptation measures to be devised. These included possible disruption of power supplies from high winds and adverse weather and port closure of more than three days caused by high tides, winds, and heavy rainfall. Higher sea levels could reduce the clearance between ships and booms, affecting loading operations and increasing stoppages in crane and pilot operations whilst the possibility of high sea levels overtopping quays could also stop port activity through the loss of crane operations.

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[95] Felixstowe Case Study, *supra* note 92.
[96] *Id.*
[97] *Id.*
[98] UKCIP, Adaptation Wizard: Step 3 How will I be affected by climate change?, http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=112&Itemid=237 (last visited July 26, 2010).
[99] Felixstowe Case Study, *supra* note 92.

Although the study only included part of the overall Adaptation Wizard, and although no high magnitude risks were identified as needing urgent attention, the process identified a number of issues which required attention. Two key issues were defined as being riverine flooding[100] and wind, two risks over which the port has little direct control. The study also allowed the port to identify a number of internal and proactive capacity building actions, including raising the awareness of the risks posed by climate change and the incorporation of these risks into flood risk management and business continuity plans.

Subsequent steps relating to implementation were not addressed at that time. Step 4 examines an organisation's attitude towards risk – how much risk is acceptable? – and considers the practicalities of implementation; building and installing the appropriate adaptive capacity and the timeline for completion.[101] Since the outcome of actioned plans may only be apparent in the longer term, Step 5 calls for a pre-emptive review of the proposals' relevancy to the envisage variability of climate and compared to other socio-economic goals the cost effectiveness of the proposals defined and the need for changes of strategy in the face of developing information.[102]

UKCIP has identified a number of principles for good adaption programmes, which should be followed in working through the Adaptation Wizard, including identifying, informing, and working in partnership with the community concerned to ensure that both uncertainties and risks are identified and understood by all. Risks include both climate and non-climate change risks and a balance must be maintained between them to maintain an overall approach, whilst focusing initially on current climate variability and the risks and opportunities they offer. Since there may be a large element of uncertainty involved in planning, it is essential to adopt a policy of continual monitoring and improvement, addressing likely solutions that do not restrict later action elsewhere.

X. Conclusions

This article has demonstrated how mitigation has been the dominant approach to dealing with climate change to date, and identified the perceived limitations of this approach, which led Parties to the United Nations Framework Convention on Climate Change to agree in Bali in 2007 that the alternative approach of adaptation should play a significantly greater role in the future global response. This is now embedded as one of the post 2012 pillars.

Although there is evidence of adaptation already taking place, it is currently piecemeal in manner and mainly based on the interpretation of policy documents. A more strategic approach is therefore needed to ensure that timely and effective adaptation measures are taken, ensuring coherence across different sectors and levels of governance. To this end, the European Union produced a White Paper in April 2009, aimed at reducing vulnerability.

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[100] Felixstowe is at the mouth of The Haven, where the rivers Stour and Orwell conjoin.
[101] UKCIP, Adaptation Wizard: Step 4 What Should I do?, http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=122&Itemid=247 (last visited July 26, 2010).
[102] UKCIP, Adaptation Wizard: Step 5 Keeping it Relevant, http://www.ukcip.org.uk/index.php?option=com_content&task=view&id=143&Itemid=268 (last visited July 26, 2010).

Similarly, on a national basis many countries are consulting on a range of adaptive instruments, with the UK being no exception and issuing a consultation document on the implementation of the Marine Strategy Framework Directive in October 2009.

A major problem, however, is the disconnect between the vertical structure of legal instruments from international conventions, through European Community law, state legislation, and what happens within the coastal communities through local government and agencies. Adaptive management shows up in coastal management plans, regional development plans, and agency guidance documents; yet it appears almost nowhere within codified statutory and regulatory text. This creates major barriers to the implementation of adaptive management with regulatory bodies and agencies having their decisions challenged by different stakeholders. The courts can only look to legislation and the common law for legal authority within the UK; and this in turn is constrained by issues of human rights in addition to the public right to be involved with environmental decision-making. Strategy and policy documents are aspirational but agency decision makers look for a mandatory duty, or at least permissory legal authority prior to carrying out adaptive management activities. The case studies demonstrate how administrative bodies in the UK *are* carrying out adaptive management measures by looking for a broader interpretation of existing legal instruments. However, as the legal cases show such decisions are constantly open to legal challenge.