APPLYING ADAPTIVE MANAGEMENT PRINCIPLES TO THE CAPE WIND DEVELOPMENT CONTROVERSY

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Decision making for natural resource management, such as forest management, park management, and marine habitat management, requires complex and science-intensive balancing acts that weigh human and environmental considerations. These management decisions are characterized by both the potential for substantial gains and the risk of negative environmental consequences. Despite the inherent uncertainty of envisioning future environmental consequences, a few key principles have evolved out of management experiences.

Managers are familiar with advice such as:

- Involve scientists at the outset of the planning process
- Make information available to the public
- Be sure to consider the human dimensions of the problem
- Think explicitly about the spatial and temporal scales of the problem
- Treat problems as experiments
- Develop an exit strategy
- Acknowledge what you can and cannot know

However, in practice resource managers and decision makers often find it difficult to follow such advice. Numerous obstacles thwart their implementation. First, legal and regulatory frameworks may not provide appropriate support to justify the time and resource-intensive processes needed to implement these principles. Timelines are set by decision deadlines and are often too short to allow managers to engage the appropriate stakeholders and to understand the problem's context. Data may be simply unavailable or difficult to attain.

As a result, resource management decisions are often delayed until they can't be pushed back anymore, and then made "on the fly". Although managers may try to use available data and the best current understanding of the problem, money and political considerations often trump scientific data and environmental considerations in decision making. Many times the determination to issue or deny a permit is a one-off decision for a unique situation.

However, while the decision recedes into regulatory history, its environmental legacy remains. Only in hindsight can the decision maker ascertain whether or not he or she would make the same determination again. While this description is simplistic, it is illustrative of many decision processes.

The principles of "adaptive management", described in section II, below, are already in use by some national regulatory agencies, such as the U.S. Fish and Wildlife Services. However, practitioners have found its principles difficult to implement. The purpose of this paper is to demonstrate how incorporating joint fact-finding principles into an adaptive management approach could help overcome such obstacles to wise decision making.

The decision makers in the Cape Wind development project are facing constraints that are no less difficult for being familiar.. There is scientific uncertainty about the impact the development may have on the natural environment. Legal and regulatory decision deadlines limit adding more stakeholders and more extensive research to the scoping of the project. Using this project as a case study, this paper proposes a new institutional structure that would help practitioners of adaptive management cope with some of this strategy's inherent implementation difficulties.

Adaptive Management

Adaptive management (AM) in natural resource *decision making* is an iterative process in which management is understood as an anthropogenic intervention, a site-specific experiment, in an ecosystem that provides new information. This approach is based on the acknowledgement that human understanding of natural systems is inherently imperfect. Therefore, policies should be planned and implemented as experiments *designed to* investigate *an* ecosystem's behavior (Lee 1989).

Typically the process involves several iterative steps. First, an initial assessment or model is created that describes ecosystem behavior. This provides information for development of a management strategy designed to achieve a desired future condition of the ecosystem, which is itself determined by the values of the decision-making organization. The model synthesizes available science to produce a description of dynamic ecological processes that operate across temporal and spatial scales. The model is intended to begin a dialogue among stakeholders about possible outcomes. Accordingly, it serves primarily to rule out impossible scenarios, rather than to make a decision on any specific option (Lessard 1998).

Once the policy is implemented, careful monitoring and observation provide data and track ecosystem dynamics. As the "experiment" proceeds and the strategy is implemented, monitoring provides feedback for adjusting the management strategy to improve its implemented, to design research to fill newly identified knowledge gaps, and to achieve the desired outcomes.

Wilhere (2002) describes two varieties of AM, passive and active. Passive AM entails formulating a predictive model, making policy decisions based on it, monitoring outcomes, and revising methods as data becomes available. It emphasizes observation and progress evaluation, but does not require controls, replication, or randomization. As a result, it cannot be used to establish cause-and-effect relationships between management policies and ecosystem changes. Active AM implements alternative policies through the design of statistically valid experiments using replication, controls, and random sampling

procedures. This enables cause and effect relationships to be defined, and policies adapted to varying system responses (Wilhere 2002).

The statistical rigor of active AM may make it seem more attractive than its passive sibling, however active AM is more complex and expensive. It may also be difficult to implement. For example, in the case of one wind farm it is unclear how alternative development strategies could be implemented on a scale sufficient to provide useful data. If varying management strategies were applied to wind farms at multiple sites, ecosystem responses might be compared, though it is not clear unclear how ecosystem variables could be controlled to permit statistically rigorous comparisons. It therefore seems that for large-scale development projects, adaptive AM would have to strike a compromise between the features that make AM appealing: site specificity and scale correctness. Passive AM emerges as the more appropriate strategy for isolated, large-scale projects.

Conventional versus AM approaches

Some resource managers tend to defer implementing management policies for an ecosystem until they understand its key processes and relationships. According to this "conventional" approach, they allow only minimal disturbance until they acquire more knowledge. However, the behavior of a relatively undisturbed system can be very different from the behavior of an ecosystem under a given management policy. Such a conservative approach may not permit the kinds of experiments and observations required to evaluate potential effects of policies. Many key ecosystem processes that scientists rely on to predict responses have effects that are visible only over large areas and long time periods. A small-scale study may not be appropriate for understanding the effects of the management policy on a larger scale. Therefore, deferring the decision in order to accumulate data does not necessarily produce valid or useful knowledge.

AM recognizes that because perfect information does not exist, managers must make decisions in the face of uncertainties. Within AM, it is assumed that managers do not have to know everything about everything before implementing a program. Instead, by using a monitoring system they can track the ecosystem's response to the change. Since any management strategy can have undesirable outcomes, this monitoring and evaluation process is critical whether the intervention is viewed as an experiment or not. The following table compares conventional and adaptive management attitudes about the objectives of formal policy analysis[2]:

Conventional	**Adaptive Management**
Seek precise prediction	Uncover range of possibilities
Build prediction from detailed understanding	Predict from experience with aggregate responses
Promote scientific consensus	Embrace alternatives
Minimize conflict among actors	Highlight difficult tradeoffs
Emphasize short-term objectives	Promote long-term objectives
Presume certainty in seeking best action	Evaluate future feedback and learning
Seek productive equilibrium	Expect and profit from change
Public provides input in pre-project discreet events	Public input is changing and frequent
Public interest perceived as aggregate	Public interest perceived as pluralistic

[2] Table adapted from Walters (1986).

AM and NEPA

The National Environmental Policy Act of 1969 (NEPA) frames the conventional process for implementing federal agency resource management policy. NEPA charges federal agencies to systematically incorporate awareness and sensitivity to the environment into their policies. The key goals of NEPA are: to encourage a productive and enjoyable harmony between man and the environment; to promote outcomes that both protect or improve the condition of the environment and that benefit human health and welfare; and to grow our understanding of ecological systems and natural resources.

Despite its lofty goals, implementation problems plague NEPA. Agencies are typically not engaged early in the planning process; ecological principles and science are not sufficiently incorporated into planning decisions. In addition, substantive objectives, such as attaining the widest range of beneficial uses of environment without degradation and enhancing the quality of renewable resources, are underemphasized. AM effectively addresses these key weaknesses of NEPA.

One important NEPA requirement is that a relevant agency monitor and evaluate its activities to protect and enhance the environment, and make this information available to the public (Phillips 2000). Because such monitoring and evaluation lie at the core of AM, it is well suited to improving NEPA effectiveness.

AM in the Context of the Cape Wind Development

Walters (1986) projected that sufficient controversy surrounding an issue may produce a crisis, or adaptive opportunity, that will promote a willingness to reexamine basic management goals. The controversy around the Cape Wind development proposal is producing such willingness. While federal and state agencies spar for jurisdiction, some groups feel left out of the current regulatory permit evaluation process. Advocate groups have lined up on either side of the issue, and the public is increasingly left to decide between these polarized groups. It is difficult for the average citizen to access reliable information about how much is known about the Nantucket Sound ecosystem and about what impacts the proposed wind farm might have on it, as well as what benefits it could provide.

Given these conditions, it is arguable that an “adaptive opportunity” sufficient to provoke the need for an alternative process for the Cape Wind proposal now exists. This paper proposes a new organizational framework and knowledge production process, using the advantageous principles of adaptive management, to convert the current cacophony into a meaningful guide for public policy decision making. Discussion of the proposal includes the benefits and drawbacks of each feature of the proposed organizational structure.

The objective of this institutional recommendation is to link the operational needs of stakeholders, including developers, residents, scientists, and government decision maker. The linkage will be achieved through an organizational framework providing a meeting place for all participants and a process for communication. As Berry et al. suggest (1998),

the alternative is a risk-averse and bureaucratic piecemeal approach by the federal, state, and local entities who have jurisdiction.

Within these agencies, budgetary and political changes often cut tenures short. Short-term officials are typically risk-averse, fearing that innovative policies with a higher risk of failure could damage fast-moving careers. Officials with short tenures may also be willing to sacrifice the long-term perspective to more immediate financial or political . Unless managers are willing to make mistakes, the experimental learning approach cannot succeed. The organizational framework suggested below will provide sufficient stability and continuity to counter the fluctuations in policy and personnel commonly occurring within environmental agencies.

The New Decision-making Organization

As suggested by Barry et. al. (1998), the new decision-making organization should have explicit authority to coordinate and manage all ecosystem management research before the final permit decision. Without such a legislative mandate, it may lack sufficient legitimacy to attract stakeholder participation, and in particular to induce federal regulatory authorities, such as the U.S. Army Corps of Engineers, to cede decision-making authority to the new institutional entity.

The new organization should be a partly autonomous, non-governmental authority with its own board of directors, professional staff, and independent outside scientific advisors. It will function as a coordinated network of individuals, who meet at a location that is practical and accessible to stakeholders.

However, creating such an institution will be difficult and time-consuming. Current decision makers may be unwilling to cede their authority to such an institution. Others may propose that a voluntary decision-making forum among stakeholders is sufficient. Despite such objections, it is worthwhile to explore what an institutional change would look like and what it could do.

In the following suggested model (see Figure 1), the new organization is comprised of five internal components, plus an independent science oversight group. The organization is directed and coordinated by the Strategic Coordination Group (SCG). The SCG is itself made up of a Steering Committee, a CEO, administrative staff, and a Financial Center.

<u>Board of Directors</u>

The Steering Committee is responsible for setting broad policy, funding, technical and scientific guidelines (Berry 1998). It is made up of long-term stakeholder representatives. As policies do not affect all stakeholders equally, as many as possible should be invited to contribute their knowledge to creating management decisions(Norton 2001). These stakeholder representatives should be identified by conflict or issue assessment (Susskind 1999) in the early stages of any development project. An inclusive process will build trust and “buy in” as working relationships and collaborative learning develop. Walters (1986) highlights the dilemma of inclusiveness that the bounding problem analysis faces. It is often difficult to designate the natural boundaries of a renewable resource system, which

define the area to be managed. Therefore, the action of defining the range of potential concerns becomes an ongoing adaptive process itself, limited by practicality. Management limits and participation will have to be established by the Steering Committee. As underrepresented interests are identified, they should be invited to join the organization. Delegates to the Committee should represent:

- local residents
- scientists and experts
- information specialists
- federal, state, and local regulatory agencies
- private interests (including developers)
- industry groups
- nonprofit organizations

These representatives should be prepared for long-term involvement in studying and contributing to an ongoing process. Sufficient involvement is necessary to allow social learning to occur (Norton 2001). The representatives should also maintain good communication with their constituents, educate them about ongoing issues, and build broad public support for the organization's process. The Steering Committee will hire and a Chief Executive Officer (CEO) and a professional administrative staff and establish a Financial Center.

Chief Executive Officer

The CEO is the new organization's official representative and top administrator. He or she is appointed by and accountable to the Steering Committee.

Administrative Staff and Financial Center

The administrative staff supports the CEO and the Steering Committee in day-to-day operation of the new organization. While delegates will usually not be based at the headquarters, the administrative staff and Financial Center will be located there. They are the physical presence of the RMO. They are also responsible for coordinating information exchange between the Steering Committee and the Working Groups, and ensuring that the Information Clearinghouse and Independent Science Oversight Group obtain the information they need.

Financial Center staff pulls together research, development, and outreach funds from agencies and other organizations having responsibility for necessary impact assessments. It allocates these funds to working group projects and research as needed (Berry 1998).

Multistakeholder Forums

Stakeholders participate in forums to discuss the scope of the research and its strategies, and exchange information. The groups represented in the Steering Committee may contribute, but other groups with knowledge to share may participate as well.

Expert Advisory Forums

Scientists and experts from a wide variety of disciplines should play a part in the expert advisory forums. They should caucus among themselves to bring clear scientific and technical information up for discussion in working groups. Scientists may conduct experiments, developed by Working Groups, aimed at monitoring management progress relative to specified criteria. The Financial Center funds this research, as well as approved research targeted at knowledge gaps identified by Working Groups.

Working Groups

Working Groups are the primary forums in which scientists and stakeholders interact on a continual basis. Working Group topics will be established by the Steering Committee, but any individual should be able to petition the Steering Committee to create a new Working Group. The Steering Committee will vote on the petition and, in conjunction with the Financial Center, will determine what funds are allocated to support the group.

In the group meetings, scientists and stakeholders will work together to transform scientific data into usable knowledge for various users and to identify knowledge gaps. Each group will be responsible for analyzing a particular set of policy options, identifying measurable criteria for evaluating those options, keeping track of monitoring data, and evaluating progress with respect to policy objectives as defined by the group and the Steering Committee. Stakeholders and experts may choose to work only within a specific working group, or may be involved through several groups. Their time commitment and involvement is determined by the Working Group in which they participate.

Information Clearinghouse

The Strategic Coordination Group is responsible for establishing the Information Clearinghouse (IC). The IC is populated by specialists in information collection and management (Berry 1998). The Strategic Coordination Group gives it project guidance and ensures that it is provided with any data it needs. The IC maintains information in a publicly accessible format on management goals, progress evaluation criteria, monitoring data, evaluation analyses, baseline data, and all data and trend analyses and modeling. It also maintains publicly accessible information on the RMO structure (Steering Committee and CEO; ongoing, past, and proposed Working Groups; and participants), completed, current, and proposed research topics; information on any other research activities in the region; budgetary information; and funding sources. This information should be publicly accessible to any interested party. In addition, the IC should explicitly triangulate with management agencies and the independent science oversight group to ensure that they have the data they need to evaluate the RMO's progress.

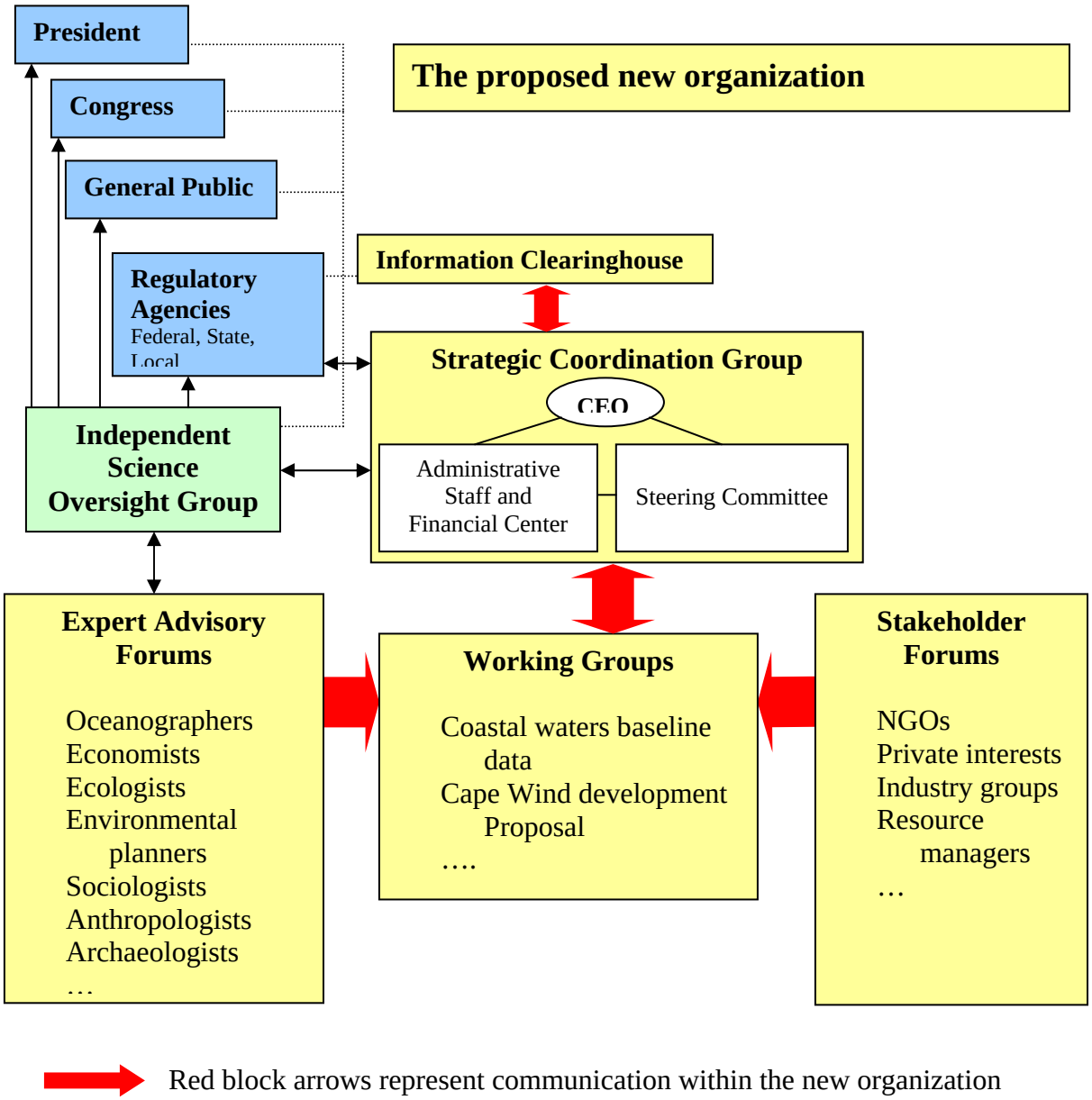
Independent Science Oversight Group

This group evaluates the effectiveness of the management strategy based on information provided through the Information Clearinghouse. In order to prevent scientists from evaluating policies they helped develop, the group should be made up of scientists independent from the new organization. The group reports directly to federal, state, and local agencies with regulatory authority, the President, Congress, and the public. It will

evaluate how management policies are actually performing relative to their stated objectives.

The feedback provided by this group is critical to the strategic coordination group. The evaluations and recommendations will be used by the new organization to modify existing policies, and to formulate new Working Groups or redirect existing Working Group agendas. This process can be iterative, and will transform permitting from a one-time decision to an ongoing and evolving process.

Figure 1.



Joint Fact Finding in the Adaptive Management Process

Having described the organizational structure that will support the AM processes, we will now examine the processes themselves. Participation in AM will occur primarily through membership in the Steering Committee and through Working Group meetings. In these workshops participants will try to establish common goals and a common understanding of the impact on an ecosystem through modeling (Bellamy 2001). These are the nurseries within which joint fact finding and collaborative learning occur. Blumenthal (2000) states that this framework is vulnerable to failure when value differences exist. However, the AM process is well suited to accommodate such fundamental differences.

The task of the Working Groups is to focus scientists and stakeholders on policy options facing a development project. Unlike in the conventional approach, researchers and end-users come together to share their knowledge about potential and actual outcomes of management actions (Bosch 2003). Walters (1986) insists that the frustration that is likely to develop about the state of affairs is healthy and productive.

The Working Groups use the models and hypotheses identified by the Steering Group to systematically develop and evaluate a range of predictions about key policy variables (Walters 1986). The discussions should begin by determining what environmental indicators should be used to measure management progress. There is no predetermined number of criteria, and so any number of indicators can be used. As Norton (2001) explains, making the plurality of values and considerations explicit is what distinguishes this kind of AM approach from the conventional approach.

Next, the group must develop experiments to establish relationships between various indicators and development goals. In this way, problems become concrete questions about what to measure and monitor. It is even possible that people with different values will come to support the same criteria. For example, people who like to fish and people who are interested in marine species conservation can agree that fish habitat is important. Without resolving their underlying differences on how to best enjoy fish, they could agree on a variable that would measure the extent to which a policy improves fish habitat (Norton 2001). In the same way, social values and values typically left out of conventional cost benefit analyses, such as constitutive values, can be measured.

Constitutive values are values that give a community member a sense of home. If these values are threatened, a person's identification with his or her home would also be endangered. These values are often independent of economic issues and difficult to quantify. A strategy to include these values in the AM process is to associate them with measurable features of the environment. Once the value can be associated with an indicator, it can be used as a criterion to evaluate potential management strategies.

The problem becomes one of finding a development path that maximizes constitutive value and other criteria. Discussion can then focus on tradeoffs that will advance specific goals. Norton (2001) suggests that a *de minimis* standard be set for each criteria, and discussion limited to policies that can be anticipated to achieve minimal levels for each (Norton 2001).

Application to the Cape Wind Controversy

One particularly difficult issue to address in the Cape Wind development controversy is characterized by this kind of constitutive value. Some residents, particularly residents of Martha's Vineyard and Nantucket Island, are apoplectic over the visual effects the wind turbines will have. The developer, Cape Wind, and opposition groups have developed conflicting simulations describing how the wind turbines will appear on the horizon.

In an AM approach, development of the project would have to proceed in order to obtain data to measure to what extent the wind farm met community management goals

including the aesthetic criteria. The difficulty is that those who feel that the sight of the turbines will destroy their sense of place, feel that the construction of a test sample of turbines will already be destructive.

A compromise might be to pursue the AM approach despite such objections, but to incorporate an exit-strategy should the project evolve into a cultural tragedy. In the true spirit of AM, the decision to develop should not be the one-time grant of an eternal permit. Instead, the permit should be issued for a period of time to be determined by one or more Working Groups that would enable scientific data to be collected to meet identified knowledge gaps. (Hypothetically, we could assume a timeframe of 10 to 20 years.)

Data from careful monitoring and observation will allow measurement criteria to be evaluated and refined. Within the context of the Working Groups, the community can discuss how well a policy is producing stated goals and how well the selected indicators and measures seem to be tracking socially important variables. Management options can then be ranked based on performance with respect to these criteria.

At the end of the permit period, a referendum could be taken on the aesthetic issue if it is still a concern.. The referendum would ask the public to explicitly evaluate, based on a set of criteria, how the development has affected their sense of place. This data would be evaluated in the context of other criteria to determine the project's effectiveness at meeting development goals. Following Norton's suggestion a *de minimis* standard could be used to evaluate the referendum.

If the goals were not being met, and a specified percentage of the population agreed that the wind farm had destroyed their sense of place, the project could be terminated and the turbines removed. An exit strategy is important because nobody wants to create a cultural tragedy in which a community is divested of its sense of place. In this way, view becomes an easier problem to deal with than ecosystem disruption. The removal of the turbines would restore the view to its original state. While this would come at considerable cost to the developer, it is conceivable that the federal government would subsidize some of the financial loss as a test case.

However, if some of those who now object come to admire the turbines and associate them with their sense of place, as proponents of the project predict, then the referendum would reflect these changed values and preferences. The wind farm project would then continue. In the spirit of AM and joint fact finding, this proposal makes use of the reality that values and preferences are not fixed, but evolve in response to environmental changes.

This kind of approach, however, makes many policy makers nervous. Typically when disagreement escalates into conflict, those with decision-making authority exacerbate the situation by exerting power to regain control, misappropriating facts to regain control over lesser-informed or irrational opponents. A more inclusive process may help prevent such situations.

Conclusion

Despite its many advantages, attempts to implement AM have been riddled with problems. As Walters (1986) laments

> Management is done by and for people; even the best ideas will be cast aside in favor of easy courses of action like pretending certainty or waiting for problems to take care of themselves. It is just too easy for people to hide behind platitudes like the need for caution, or the importance of detailed understanding before action, or the need to apply methods and models that have stood the test of time (usually without any real test, of course) (1986).

As long as human nature is risk-averse and resistant to change, it will be difficult to implement AM. However, the current regulatory crisis in response to the Cape Wind controversy may be sufficient to expose the weaknesses of the conventional system and stimulate an eagerness for something different. AM has the advantage of radically changing the way people think about policies, from one-time actions to ongoing experiments that are reflective of the dynamic ecosystems and communities they affect.

In order to move the regulatory process in this direction, new ways to implement the principles of adaptive management must be developed. Such a process will require scientists to accept dissent within their community and publicly admit uncertainty. The process described here should encourage scientists, policy makers, and other stakeholders to trust each other to deal directly and competently with complexity and uncertainty. They must explicitly endorse and support collaborative research and adaptive management processes that address these issues head-on. Commitment to long-term engagement has the potential to improve the ways we manage our natural resources and our diverse interests.

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