Science, Democracy, and Administrative Decisionmaking: The Case of Marine Reserves in the Northwestern Hawaiian Islands

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ABSTRACT

This paper examines the tension between democracy, science, and rulemaking in highly technical policy areas. The paper opens by looking at how democratic and scientific decisionmaking processes conflict in theory and then explains how rulemaking institutions have evolved over time in an effort to meet these conflicting demands. Drawing, in part, on this history, the paper then develops a series of broad propositions meant to begin to reconcile democracy and science in the rulemaking process and briefly applies those propositions to the development of Marine Protected Areas (no-take ecological reserves).

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> On the global warming alarmists, anyone who actually points to the evidence that disproves their apocalyptical claims, they don't engage in reasoned debate. What do they do? They scream, 'You're a denier.' They brand you a heretic. Today, the global warming alarmists are the equivalent of the flat-Earthers. It used to be that it is accepted scientific wisdom the Earth is flat, and this heretic named Galileo was branded a denier.
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> Sen. Ted Cruz, in an interview with *Texas Tribune*.[1]

In highly technical policy areas, interests and science often clash in ways that leave both scientists and policymakers frustrated and confused. At first glance, it may appear that there is no obvious tension between a democratic policymaking process and science. We can imagine any number of scenarios in which science can be and has been one of many tools utilized by policymakers to guide them in making the value-laden decisions we expect them to make in a democratic polity. In the simplest version of this kind of policymaking process, elected officials or their agents seek and acquire expertise from scientists who are presumed to be providing neutral and objective information with respect to the policy question at hand.

There are several problems with this idealized view of policymaking in highly technical policy areas however. First, policy (even in relatively non-technical policy areas) is always made within a context of some uncertainty (imperfect knowledge). Ideally, science helps to narrow the scope of that uncertainty. But science does not always have all the answers. And when there is significant scientific uncertainty in a policy area, "the science" can actually become a hindrance rather than an aid as competing groups of experts may provide confusing, contradictory, and even distorted information to policymakers. This is particularly important given that more and more of what is being decided by policymakers is policy within so-called

[1] Philip Bump, "Ted Cruz compares climate change activists to 'flat-Earthers.' Where to begin?" *The Washington Post*, March 25, 2015. http://www.washingtonpost.com/blogs/the-fix/wp/2015/03/25/ted-cruz-compares-climate-change-activists-to-flat-earthers-where-to-begin/

"frontiers of science" where the scientific community has not yet reached a consensus. Pick any significant policy area and it is invariably the case that scientific uncertainty is somehow a big part of the fight in the more controversial parts of that policy area. In agricultural policy, there is the issue of genetically-modified foods, in health policy, there is the issue of stem-cell research, and, in energy policy, there are controversies with respect to the waste products from both "clean" coal and nuclear power. In each of these areas, interests on all sides frequently marshal their own scientists and their own science and the public and policymakers alike are frequently left confused and bewildered. In fields such as these, the "science" often not only fails to illuminate, it can lead to intransigence and gridlock as various sides dig in clinging to their accepted version of scientific truth.

A second complication to the idealized version of policymaking in scientifically-complex policy areas has to do with concerns about technocracy. Several observers have voiced concern that technical policy areas may increasingly become the sphere of "experts," leaving traditional policy constituents behind. This is not a new concern in American political culture. The democratic impulse that Alexis de Tocqueville identified in Jacksonian America is, in some ways at least, at odds with the idea of technocracy or rule by experts. Martin Shapiro refers to this rule by experts as the "Hamiltonian" impulse in American political culture – the view "that those who know how to do something ought to be in charge of doing it" (Shapiro 1988, 57) and Shapiro argues that Americans hold both these contradictory views at least to some degree all the time. Moreover, America's political institutions, including the regulatory processes that have become a part of that institutional structure, are a reflection of this contradictory political culture.

This paper seeks to begin the process of bridging the gap between science and democracy by advancing a model of science-based regulatory processes where policy decisions are based on

stakeholder input but constrained by scientific efficacy. While there has been an enormous amount of scholarship on the influence of executives and legislatures on environmental policy, most key policy decisions in highly scientific or technical areas decisions are made at the administrative level, where there has been relatively little study in comparison. The model we seek to advance is, in effect, one step beyond negotiated rulemaking, where an agency's proposed rule is driven by a consensus-based group process and reviewed by an independent science panel. This model, in contrast, brings together a science advisory panel which works in consultation with the consensus-based group to provide technical expertise and science-based tools for better policy. Finally, we seek to illustrate this model by briefly applying it to the establishment of an ecological reserve in the Northwest Hawaiian Islands archipelago.

Problem Identification

The core assumptions and methodologies of science and policymaking are fundamentally different. Science is empirical – explaining what is rather than what ought to be. It assumes a high degree of training and expertise so, by definition, access is limited. There is a narrow protocol of acceptable methodologies and outcomes are empirically justifiable according to these methodologies. In contrast, democratic policymaking is normative – defining what we ought to do. It assumes multiple interests and stakeholders. There is no agreed upon protocol – multiple methodologies are utilized. Policy outcomes are not empirically justifiable and policymaking access is – at best – unlimited. Table 1 summarizes these concepts together for comparison.

Table 1. How Do We Know What We Know? Differing Assumptions of Science and Democracy	
Science	**Democracy**
Empirical – Explaining what *is*	Normative – What *should be*
Assumes high degree of training & expertise	Assumes multiple interests / stakes – no expertise required
Narrow protocol of acceptable methodologies	Multiple methodologies – no agreed upon protocol
Access is limited	Access is (at best) unlimited
Outcome is empirically justifiable	Outcome is not empirically justifiable

If we think about the scientific method and the democratic policymaking process as two different protocols we can utilize to answer a question, we can see how scientists and policymakers may come to see the world differently. This wouldn't be a problem as long as scientists and policymakers don't work together. But when scientists and policymakers are forced to work together, as they are in scientifically complex policy areas, it is not surprising that the two groups tend to misunderstand one another and view one another with suspicion. Stated another way, if science is rational and empirical and democracy is non-rational and normative, there is bound to be conflict when the two come together in the policymaking process.

For our purposes, it is useful to focus on three particular differences between science and democracy as decisionmaking processes. We might think about these three differences as the answers to three different questions: Who can and who does participate? What is the range of acceptable methodologies? And what is the role of values and opinions?

Participation. Democracy is a decisionmaking process that invites widespread participation and, ideally, all citizens have equal influence on the outcome. In practice, we know that not everyone participates and, among those who do participate, influence is not equally shared. But, even with that caveat, real-world democratic decisionmaking processes do allow for

relatively widespread participation and influence. In contrast, participation and influence in technocratic decisionmaking processes are, by definition, limited to those with the proper training and expertise. One important implication of the wide divergence in levels of participation between these two decisionmaking constructs is that the "scope of conflict" is likely to be very different in democratic vs. technocratic processes.

There is an additional issue here related to organizational culture. We might think about potential participants in policymaking in highly technical policy areas as individuals existing in at least three distinct organizational cultures. One group is research scientists, whether in academia or industry, another group is government regulators working within governmental bureaucracies, and another group is members of the public and of various interest groups. As a general claim, it is fair to say that research scientists come from a significantly different organizational culture than agency bureaucrats and the organizational cultures of individuals in private industry firms and interest groups are different as well. As we open up participation (the democratic ideal) to a wider array of individuals with these varying world views, conflict is a likely outcome. And as participation is limited to those from just one of these world views (research scientists), conflict is less likely but the pathologies of groupthink become more possible.

Methodology. We refer to democratic and technocratic process***es***, in the plural, above because there is more than just one acceptable method or process in each case. But there is a much wider variance and degree of difference among acceptable democratic decisionmaking processes than there is among technocratic or scientific decisionmaking processes. Among western democracies there is a variety of different forms of government, all of which are considered democracies. Indeed, even within a given regime such as American constitutional

democracy, there is a wide variety of different kinds of democratic decisionmaking processes. From the famed New England town hall to ballot initiatives to legislative processes to regulatory decisionmaking processes, there is seemingly no end to the number of different forms of decisionmaking processes that invite public influence and participation of one kind or another. Scientific decisionmaking, on the other hand, is really only considered acceptable when it conforms to a very narrow range of protocols that we tend to summarize as "the scientific method." Though specific definitions vary at the margins, the scientific method would seem to include the formulation and articulation of hypotheses to be tested, the collection of data, whether through experimentation or observation, and finally, the development of conclusions based on logical reasoning. For conclusions to be accepted as fact, scientific findings are generally subjected to peer review and other scientists seek to replicate results. Where there remains the possibility of a narrow range of variety in processes that meet these criteria, for our purposes here, the important point is that there is not a wide variety of acceptable scientific methodologies or protocols in coming to a decision.

The Role of Values, Opinions, and Preferences. Perhaps the greatest difference between democratic and scientific decisionmaking processes has to do with the role of values, opinions, and preferences. Classical liberal democracy is based upon the premise that citizens agree to disagree about absolute truths, preferences of competing values, and what constitutes "good" or "better" public policy. Combatants in the policy process submit questions to a vote and the group with a majority of votes (or sometimes the greatest number) gets its way. Competing values, opinions, and preferences are the lifeblood of democratic decisionmaking processes and some, applying economic thought to the political realm, even argue that ideas and values "compete" in a marketplace that elevates good ideas and values and discards those that

are bad. The argument itself is a fight over what *should* be, a normative one rather than an empirical one. In scientific and technocratic decisionmaking processes, on the other hand, the fight is over what *is*. Values, opinions, and preferences have no (or at least, in theory, shouldn't have a) place in the discussion. Scientists are not interested in what the force of gravity should be or what substances should and should not be toxic. They are interested in explaining what is, not what should be. While Sheila Jasanoff (1990, 12-17) argues persuasively that the reality of the production of scientific knowledge is not quite as value-free as we depict it above, there are at least two important reasons that the normative/empirical distinction between democracy and science still makes sense for our purposes. First, granting that values, opinions, and preferences do sometimes seep into scientific studies and technocratic decisionmaking processes does not change the fact that, as a relative matter, values, opinions, and preferences play a much larger role in democratic processes. Second, and perhaps more importantly, to the extent that values, opinions, and preferences are part of the production of scientific knowledge, they serve to de-legitimize the outcome.

Rulemaking as a Key Battleground

The Administrative Procedures Act (APA) of 1946 defines a rule as "the whole or part of an agency statement of general or particular applicability and future effect designed to implement, interpret, or prescribe law or policy" (5 U.S.C. 551). To put it in layman's terms, a rule is a policy promulgated by an agency that clarifies how a provision of law is to be interpreted or carried out. Regardless of how it happens, it happens a lot and it knows no partisan bounds. According to Cornelius Kerwin (2011, 22), the average annual number of pages in the Code of Federal Regulations was over 138,000 by the end of the Clinton

administration and nearly 158,000 by the end of the George W. Bush administration. Importantly for our purposes, it is not just the volume of policymaking that is occurring during rulemaking that matters but also the content of the issues at stake. As we describe in greater detail below, one reason why legislators frequently delegate rulemaking authority to administrators is because they lack the scientific or technical expertise to solve a policy problem. The point is that rulemaking is really where the scientific process and the democratic policymaking process are most likely to clash.

In practice, institutional design in regulatory politics has reflected a desire to respond to the competing and contradictory aspects of American political culture (democracy and technocracy) described above. But this conflict is aggravated by the reality that regulatory processes are far from **both** the democratic and technocratic ideals described above. Rulemaking, as originally practiced, was not particularly democratic nor did rulemaking in technical policy areas conform to the ideals of the scientific method. In order to understand this conflict more clearly, we need to look at how applied rulemaking processes are pale cousins of the legitimizing ideals of democracy and the scientific method and we need to look at some of the efforts institutional innovators have undertaken to democratize and technocratize these processes. Each of these reforms has fallen short or has been flawed in at least some important way. To highlight some of this history, to demonstrate how intractable this problem has been over time, and, more importantly, in order to tease out some lessons, in the sections that follow, we discuss four of these particular institutional innovations in more detail. Two of these institutional innovations ("the best and the brightest" and "science advisers") have been efforts to bring better science to the regulatory process. Two of these institutional innovations ("notice and comment" and "negotiated rulemaking") have been efforts to bring more participation and

democracy to the regulatory process. While each has failed to fully legitimize rulemaking or resolve the tension between science and democracy, each marks a substantial step forward in integrating democracy, science, and regulation.

The Best and the Brightest. The technocratic ideal is to hire individuals with the scientific or technical expertise to do a job and then allow them to do it. One of the earliest "solutions" to the tension between democracy and science in highly technical policy areas was a slight variant of this technocratic ideal: Hire scientists into government service in a new breed of regulatory agencies but require some accountability by putting political appointees in charge of them. So, in the case of EPA for instance, scientists are hired who have technical expertise in the areas of air quality, water quality, etc., but you create an institutional structure where these scientists must be accountable to an EPA Administrator, to the President who appoints the EPA Administrator and to members of Congress who authorize and fund the EPA.

After decades in existence, for better or worse, we now have ample evidence that political appointees influence the agency according to the President's (and sometimes, members of Congress') ideological viewpoint. A 2008 study by the Union of Concerned Scientists makes its findings clear in the title – "Interference at the EPA." This study, which comes from the technocratic perspective of scientists and focused on EPA under the George W. Bush administration, conducted a survey of scientists at EPA and found that 60% of scientists "personally experienced at least one incident of political interference during the past five years" (UCS 2008, 2). More to the point, the study found that 22% of EPA scientists "had personally experienced frequent or occasional 'selective or incomplete use of data to justify a specific regulatory outcome'" (UCS 2008, 2).

While these kinds of findings are disturbing to environmentalists as well as scientists, they also highlight the nature of the problem at issue in this paper and the problematic nature of this particular solution. The Union of Concerned Scientists study concludes:

> Science is not the only element of effective policy making. However, because science enjoys widespread respect, appointed officials will always be tempted to manipulate or suppress scientific findings to support predetermined policies. Such manipulation is not only dishonest; it undermines the EPA's credibility and affects the health and safety of Americans (UCS 2008, 8).

The interference of Bush Administration officials (particularly the amount of interference and types of interference alleged in this study) is certainly inappropriate and inexcusable. But the study's conclusions, like the one above, seem to implicitly suggest that there is not much of any proper role for political appointees at EPA. The study concludes at another point, "While the White House is responsible for overseeing federal agencies, it must strike a better balance between administration priorities and agency independence" (UCS 2008, 7). To be fair, the study does call for more open and transparent decisionmaking processes, steadier funding streams, and acknowledges that EPA scientists are not sole decisionmakers. But the "balance" that is implied here, however, seems to imply that scientists need more freedom to make decisions without political interference because "The EPA's scientific enterprise is our nation's first line of defense against threats to public health and the environment" (UCS 2008, 8). It is a solution to the tension described here that embraces a too-simple technocracy.

The "best and the brightest" as a solution is also problematic because the scientists hired by government agencies are "hybrid" characters of a sort. As described above, the work of "regulatory science" differs in content and context from that of "research science." The scientists working at regulatory agencies themselves are neither purely scientists nor purely agency bureaucrats. But the important point for our purposes is that their decisions cannot be

easily legitimized from a democratic perspective nor can their scientific findings be easily legitimized from a technocratic perspective because they lack the legitimacy of scientific findings in peer-reviewed academic journals. From a scientific perspective, they exist in an odd institutional location. Describing the EPA's difficulties in the 1970s, Jasanoff argues,

> The legal framework within which EPA operates magnified the difficulty of maintaining scientific credibility. Like all U.S. administrative agencies, EPA carries out its scientific affairs in the open, with numerous opportunities for interested parties to contest its choices and decisions. The adversarial format of these encounters afforded EPA little opportunity to maintain a posture of neutrality (Jasanoff 1992, 200).

Hiring the best and the brightest scientists into government is obviously useful and important. But the best and the brightest could not resolve the various tensions between science and democracy in the highly technical policy areas outlined above.

Notice and Comment. As described above, the Administrative Procedures Act of 1946 (APA) was enacted as a backup statute and as a way of codifying existing rulemaking practices for a variety of agencies. At the heart of the rulemaking provisions in the APA, was a set of institutional reforms intended to democratize rulemaking. Agencies were required by the law to provide notice of their intent to regulate, were required to receive comments from interested parties, and agency decisions were to be reviewable by the federal courts. Taken together, these provisions were referred to as "notice and comment" provisions and their democratizing reach, as interpreted by federal courts, would go far beyond what the authors of the original APA could have imagined. R. Shep Melnick (1989) argues that, by the 1960s, with the Congress solidly in Democratic hands and with the federal courts dominated by more liberal, activist judges, the Congress and the courts formed an institutional alliance of sorts that served to open up the black box of rulemaking, among other governmental processes, to greater public participation. Congress would enact laws delegating sweeping authority to new kinds of regulatory agencies

like the EPA and OSHA while the courts would uphold and even expand the rights of groups and citizens to participate in rulemaking and ensure that agencies had made a rule that was based on the comments received from groups and interested citizens.

In his description of the same trends, Martin Shapiro (1988) argues that the evolution of rulemaking procedures in this era might be thought of as a move from pluralism to a sort of hyper-pluralism in which courts play a larger and larger role in adjudicating disputes. This occurred in a variety of different procedural steps. First, standing (the legal right to sue in courts) was expanded to allow individuals and groups to challenge regulations while meeting lower thresholds of "injury." Next, agencies were required to provide greater notice about rulemaking proceedings both in terms of the kinds of data the agency was planning to use and in terms of the kinds of alternative regulations the agency was considering (Shapiro 1988, 45-46). Next, agencies were required to prove they had listened to interested comments from groups and citizens by engaging in "dialogue." Courts required that they respond to all comments they received to prove they had listened. This "dialogue" meant that there would now be a new creation, something called "the rulemaking record," and congressional statutes and the courts increasingly began referring to this record as the official record of the rulemaking proceeding. Next, if some groups did not have the economic resources to participate, agencies would be required to provide public funding to assist them in gaining access. Finally, the existence of the "rulemaking record" now allowed courts to insist that agencies engage in "reasoned decision making." This was the creation of the so-called "hard look" doctrine wherein courts declared that they would use the rulemaking record to take a hard look at the evidence to ensure agencies had used reasoned decision making to come to the right decision (Shapiro 1988, 45-49).

This hyper-pluralist endpoint of a democratizing trend in rulemaking is ironic since judges and courts are hardly democratic institutions. Neither do they have any special claim to technical expertise. More importantly, it is suggestive of the ways in which the "notice and comment" scheme also ultimately fails to resolve the tensions between science and democracy in highly technical policy areas. As Shapiro (1988, 56) points out, the original test (in the APA) for judicial intervention was "a sort of lunacy test." Judges were to make sure that the agency had made a decision based on the proceedings and courts were only to invalidate a rulemaking if the resulting rule was "arbitrary and capricious." By the late 1970s, however, when hyper-pluralism had elevated the role of judges, groups, and even individuals in the rulemaking process, the role of science and the definition of what constituted good science was becoming twisted. The method for finding the "right" regulation in a highly technical policy area had become an adversarial proceeding and usually a formal one in court since it was likely some group would end up unhappy enough with the outcome to sue. In short, the "notice and comment" paradigm had not resolved the tension between science and democracy in highly technical policy areas so much as it had "judicialized" the relationship, a result that confers neither democratic nor technocratic legitimacy.

Science Advisers. Another technocratic innovation in rulemaking processes has been the use of science advisers either in some kind of permanent advisory board or in ad hoc task forces assembled for particular rulemaking proceedings. The rise of science advisers outside the regular scientific bureaucracy of an agency might be viewed as the bureaucratic equivalent of academic peer review. The idea of peer review in the academic setting is that consensus around findings can be established as the methodology and conclusions of research under review can be validated by objective outsiders with credentials in the field. As the scientific findings of

regulatory agencies came under increasing attack, agencies turned to science advisory panels both for scientific advice and to provide outside validation of agency scientific methods and findings.

While the use of scientific advisers and these science advisory panels can (and do under certain conditions we outline later) help to validate and legitimize the science used in regulatory processes, there are at least two reasons this solution fails to fully resolve the tensions raised earlier. The first reason has to do with the problems associated with the nature of regulatory science outlined above. Regulatory scientists are frequently asked to engage in predictive risk assessment, are frequently required to extrapolate findings from one environment to another, and most importantly, they are frequently confronted with policy questions that contain some values component. In this environment, the regular processes of peer review, particularly if they are conducted by outside scientists used to an academic peer review environment, are unlikely to yield a review that will reflect well on the agency. In her book on the role of science advisers, Jasanoff (1990, 8-9) asks, "If the scientific claims that these bodies are asked to evaluate are uncertain, insufficient, and inherently mixed with policy, then how can advisers selected for their technical expertise and political neutrality possibly certify them as valid science?"

Jasanoff also suggests a second reason science advisers fail to resolve some of the conflict surrounding rulemaking in highly technical policy areas. She argues that, even in academic settings, peer review is not so successful in establishing consensus on methods or conclusions in areas where there is not already a fair amount of consensus. At best, the establishment of consensus in areas of prior conflict takes a significant amount of time and multiple iterations of research and review. Again, these are elements that are unlikely to be present in peer review of science in the regulatory environment.

> the benefits of peer review (and, more generally, of scientific advice) for regulatory science may have been oversold. If peer review is most effective at cementing consensus among scientists of similar disciplinary training and outlook, then the chances are that the process will prove much less successful when it is carried out under uncertain theoretical and methodological constraints, as well as under the pressure of politics and regulatory deadlines (Jasanoff 1990, 62).

Like the hiring of the best and the brightest and the rise of more open, participatory rulemaking processes, the use of science advisory boards has been a positive development. But it is not the panacea some once imagined.

Negotiated Rulemaking. The final institutional innovation we discuss in this section, and the most recent, is the rise of negotiated rulemaking. Writing with some concern about the state of overly judicialized and painfully lengthy rulemaking procedures in 1988, Martin Shapiro (1988, 168) argued, "These delays can only be reduced if we gain more voluntary collaboration and compliance from the affected groups." He predicted,

> So, without abandoning our concern with achieving the public interest rather than the mere sum of interest group preferences, administrative law will seek to add more deliberative, less adversarial adjudicative mechanisms to the rule-making process (Shapiro 1988, 168).

Indeed, some agencies, like EPA, had been experimenting with regulatory negotiation at the very time Shapiro was writing and, not long after that, Congress enacted the Negotiated Rulemaking Act of 1990. Negotiated rulemaking is a voluntary (at the agency's discretion) add-on to the traditional rulemaking process in which an agency convenes a group of stakeholders to attempt to negotiate a regulation that (if consensus is reached) is then proposed to the agency before a traditional rulemaking process begins.

As Shapiro noted, the major potential benefit of negotiated rulemaking is that the interested parties have an opportunity to try to work out areas of disagreement prior to a potentially adversarial traditional rulemaking process and the potential litigation that all-too-

frequently follows rulemaking. Remarkably little research has been done on negotiated rulemaking in practice but much of what has been written on the subject has been less than positive. Critics (Coglianese 1997, Siegler 1997, Coglianese and Allen 2004) argue that stakeholders rarely achieve consensus, regulatory procedures take at least as much time as before, and that litigation after rulemaking is even more common than with traditional rulemaking processes though Langbein and Kerwin (2000) dispute this latter finding. Additionally, Langbein (2002) finds that negotiated rulemaking may have a tendency to advantage groups that are already better organized and have greater resources. On the other hand, some research finds that negotiated rulemaking yields important benefits. For instance, Furlong and Kerwin (2005, 268) report that interest groups prefer negotiated rulemaking processes if given an opportunity to participate, Langbein (2000) concludes that participants in negotiated rulemaking find the agency to be more responsive, and Langbein and Kerwin (2000) find that groups participating in negotiated rulemaking processes tend to learn more, that groups come away more satisfied with the substance of the rule that results, and most importantly for our purposes, that rules selected for negotiation tend to be more complex – a category that would include the technical kinds of policy problems with which we are concerned.

Within the framework of democracy and science that has been discussed here, negotiated rulemaking thus represents a very qualified step forward. From the perspective of democracy, negotiated rulemaking adds at least another avenue of participation for interested groups and groups that participate generally report greater satisfaction with the process though, as Langbein (2002) reports, it is not clear all interests are treated equally. Another potential problem, from the perspective of democratic legitimacy, is that there is no evidence that negotiated rulemaking speeds up the rulemaking process and, although Coglianese's (1997) finding that litigation is

more common with negotiated rulemaking processes has been disputed, there is no evidence that negotiated rulemaking has helped to lessen the amount of litigation that follows rulemaking. There is greater participation and greater satisfaction with the process (at least among some), and these are worthy benefits.

Perhaps more surprisingly, negotiated rulemaking also represents a very qualified step forward in terms of the science in highly technical policy areas. At least some evidence exists (Langbein and Kerwin 2000) that stakeholders "learn" more in these processes and that learning would certainly include a greater understanding of the technical and scientific issues involved. It is also important to note that, from the perspective of the agency, negotiated rulemaking can yield greater informational gains as the agency collects scientific data both in the negotiation phase and the more traditional notice and comment phases of rulemaking. That said, negotiated rulemaking cannot yield scientific consensus where none had existed prior to the process nor, to be fair, is it a process intended to do so. Negotiated rulemaking thus represents a qualified step forward for legitimating policy decisions in highly technical policy areas but, like the other qualified steps forward described above, it is not, in itself, a silver bullet.

Some Tentative Lessons

The preceding discussion suggests some tentative lessons. Rulemaking, as it is practiced, is neither fully democratic nor fully technocratic. Institutional innovation has arguably been the only constant. While the paradigmatic tension between democracy and science has not been resolved, most of these institutional innovations have yielded incremental steps forward and lessons for future rulemaking procedural design in these highly technical policy areas. So, what are some of the key lessons we can tease out of this history?

Widespread (But Guided) Participation. In the nearly seven decades since the enactment of the Administrative Procedures Act, institutional innovators have worked to encourage greater participation and accountability in rulemaking in a host of ways from notice and comment provisions to the dialogue requirement to the rise of negotiated rulemaking. In the abstract, greater citizen and interest group participation is a good thing but it has come with significant costs. One cost is that rules take a very long time to make. Kerwin and Furlong (1992) find that rulemaking in EPA's various programs takes a minimum of two years and often as much as five years. They (Kerwin and Furlong 1992, 119) hypothesize that the greater the "political activity," the longer it will take to make a rule and in the technical and frequently controversial policy areas with which we are concerned, there is certainly not likely to be a shortage of willing participants engaging in political activity to shape a final rule at all stages. Furthermore, delay is not just a matter of temporal frustration. When we decide to make a rule, we're presumably doing it to address a pressing problem such as contaminated water, a threatened species, or workplace safety. As rulemaking drags on, the problem is likely getting worse or even becoming irreversible.

A second cost of greater participation in the rulemaking process is more of a normative concern and one directly related to the paradigmatic tension between democracy and science we outlined earlier. Especially in highly technical policy areas, we wouldn't want rules to be just the sum of group preferences without regard to "good" science. Martin Shapiro makes this point well in explaining why institutional innovators always have to be concerned with more than just greater participation in the rulemaking process:

> We are no longer content to say that, because everyone has his or her own ideas of right or wrong, the only good public policy is one which every relevant group participated in forming. If all the groups took part in the ecological plan, but all

> the fish in the river died, we are not prepared to say that the plan was right (Shapiro 1988, 13).

In short, greater participation cannot be an end in itself in rulemaking. Rather, it must be a means to both strengthening and legitimizing reasoned decisionmaking in the rulemaking process.

So, how do we incorporate the participation we need in rulemaking without allowing it to become simply an unending democratic event that does not respect science? There is no easy answer to this question but the evolution of rulemaking procedures we described above points the way to some important lessons. While notice and comment provisions, dialogue requirements, and the rise of negotiated rulemaking have provided a healthy democratic corrective to what had been a more closed, technocratic process, we need to find formal or informal ways of keeping these processes from stalling or blocking action altogether. One general way to do this is to make rulemaking processes less adversarial, less contentious, and more cooperative. Agency behavior would seem to be key here. There are a variety of things agency personnel can do to either head off or de-escalate conflict in what is a naturally conflictual process:

1) Early Participation. Bringing stakeholders into the process earlier is always good. If important decisions about the scope of various sub-groups' work or even the membership of important sub-groups have been made before a stakeholder is included, that person or group may have good reason to object to the process or to object to an outcome on procedural grounds. Allowing stakeholders to own the process earlier, rather than later, can help.

2) Participation in Choosing Science Advisers. One of the most important "traps" in making policy decisions in highly technical policy areas is conflict over who the scientists are, their potential conflicts of interest, and questions about their credentials. Agency personnel should

make sure that stakeholders agree on the validity of the science advisers before the science advisers make decisions. Just as stakeholders need to own the process, they need to own the selection of science advisers.

3) Finding Areas of Agreement Early. Finding areas of agreement among stakeholders is critical for two reasons. First, tremendous time can be saved if participants do not waste time arguing about what is already agreed upon. While there are almost always going to be areas of significant conflict, simply agreeing on the dimensions of the problem or some aspect of a solution allows the rulemaking process to focus in faster on areas of conflict. Second, finding areas of agreement among stakeholders expecting a fight can create greater esprit-de-corps for the difficult fights to come. It can signal that one stakeholder shares at least some common view of the world with another and the conflict to come may no longer seem quite as intractable.

4) Top-Down and Bottom-Up Participation. In reviewing best practices in MPA formation, the National Marine Protected Areas Center (2004, 9) argues that both "top-down" and "bottom-up" models of participation should be employed. Top-down models are those in which centralized agency personnel lead the process of identifying specific areas for protection and imposing those laws on local resource users. Bottom-up models are those in which local stakeholders are included to a greater degree in development of a resource protection plan. Each of these models has drawbacks on its own as top-down models may fail to take account of local circumstances and needs and may face difficulty in implementation as local interests resist and bottom-up models may not be as sensitive to "strategic scientific and resource management objectives" as necessary. For this reason, "the ideal may be a management approach that is government-driven ('top-down') but that heavily involves stakeholders ('bottom-up') (National Marine Protected Areas Center 2004, 9)." How much of each depends on the local situation and the resource

management objectives. The point is that resource managers need to understand this tension and avoid a "one size fits all" model of participation in resource management (National Marine Protected Areas Center 2004, 10).

Science Advisers That Work. As noted above, the selection of science advisers has to be carried out in a way that allows stakeholders to "own" the choices they make. But, just as the rule needs to be more respectful of science than just being something all the interested groups can agree upon, the science advisers need to be more than just being a group of scientists the stakeholders agree upon. Jasanoff (1990) reviews the work of science advisers in a variety of settings and finds that, while the use of science advisers is generally a step forward in managing the tension between democracy and science in highly technical policy areas, all too frequently, we are still confronted with "the failure of this institutional innovation (science advisory committees) to 'silence controversy' in highly technical policy areas" (Jasanoff 1990, 2). So what are the qualities of good science advisers, how do we choose the 'right' science advisers, and what are some best practices in science advising?

1) Experience With and Understanding of Regulatory Science. We outlined some of the important differences between regulatory science and research science above. One useful criterion in identifying "better" science advisers is to choose advisers who understand and are experienced with this important distinction. Very often academic research scientists are dismissive of government generally and of agency scientists in particular. Putting scientists with this type of attitude on a science advisory board can be problematic for obvious reasons. In reviewing some positive practices in the appointment of EPA Science Advisory Board members, Jasanoff points out

> It is not uncommon for scientists to be socialized into the advisory culture by serving the Board in several different capacities. For instance, an expert who

> initially advises the SAB as a consultant may later be recruited as a full-fledged Board member. In this way, it has been possible for EPA to create a network of scientists in sympathy with the agency's peculiar combination of scientific and political work (Jasanoff 1990, 94).

While experienced science advisers may not always be available, the critical point here is to find advisers who understand the nature of the applied science that needs to be done. At the very least, science advisers from the academic and industrial research communities need to be oriented in some way to the different kind of work involved in regulatory science.

A related concern has to do with the diversity and level of focus of expertise needed among science advisers. While the incentives among academic and industrial scientists are to narrow their focus to particular micro-fields of subfields, regulatory science usually requires synthesizing knowledge from a variety of fields. Again, with regard to the EPA Science Advisory Board, Jasanoff (1990, 94) argues, "Over-specialization is therefore a disadvantage for SAB scientists, who must be able to interact with experts in fields that are quite peripheral to their own." Putting all this together, Jasanoff (1990, 243) concludes, "The most valued expert is one who not only transcends disciplinary boundaries and synthesizes knowledge from several fields but also understands the limits of regulatory science and the policy issues confronting the agency."

2) Early, Frequent, and Continuous Participation of Science Advisers. The initial models of science advising treated science advisers simply as peer reviewers of agency scientific efforts. Agency scientists would study problems, develop alternatives, and propose solutions, and then submit their data, findings, and proposals to science advisory boards for confirmation (or rejection) of the scientific legitimacy of their efforts. This model proved to be problematic for a variety of reasons. First, this simple "peer review" model did not take full advantage of the expertise science advisers could offer. Suggestions on methodology, data sources, the latest

scientific literature, etc., from cutting-edge scientists could have been employed earlier rather than later. Second, the "peer review" model set up an adversarial relationship between agency scientists and the agency's science advisers and frequently led to adversarial scientific hearings with agency scientists on one side and interest group scientists on the other and with science advisers acting as quasi-judges. This did not prove to be a model for successful integration of science into the regulatory process. After describing the use (both successful and not) of science advisers at EPA and FDA, Jasanoff concludes that science advisers can succeed only if they are part of the regulatory scientific enterprise before, during, and after rulemaking

> This stabilizing impact of expert advice can be observed at four critical junctures in the evaluation of regulatory science: validation of long-term research strategies; certification of study protocols and analytical methodologies; definition of standards of adequacy for scientific evidence; and approval of inferences from studies and experiments. Admitting the scientific community into each of these areas of decisionmaking produces a stronger consensus than any achievable through the agency's in-house expertise alone (Jasanoff 1990, 237).

In short, peer review is probably not the right metaphor for regulatory science. Rather, "scientific peer involvement" from start to finish is a more workable strategy.

Negotiation and Boundary Work. Legitimating the science behind a regulatory decision is no small task. This is the case both because of the ways in which our desire for democratic legitimacy (more widespread participation, equality of influence, etc.) conflicts with schemes of scientific legitimacy and because regulatory science is less sealed off from values questions than research science. In order to deal with this latter concern, a number of observers call for both negotiation among scientists and between scientists, agencies, and the public and the creation of some kind of boundary between the democratic and scientific processes involved in a particular rulemaking (Jasanoff 1990, 234).

1) Negotiation. Though it would seem to violate the norms of the scientific enterprise, the nature of regulatory science requires that differences among scientists and even between scientists and others sometimes be negotiated. Even within scientific areas where much is known and much research has been done, there is invariably far more we don't know. Furthermore, it is often the case that we are making rules in the very areas where we know the least from a scientific standpoint. After all, why call in the experts if a consensus already exists? If that were the case, we could simply look up the answer in a textbook rather than hiring science advisers. Finally, while scientific arguments in academia can become heated, the heat is certainly raised to a new level when a new policy depends on the science. Sarewitz argues that scientific uncertainty combined with a policymaking process can be a formula for gridlock.

> If a field of research makes the transition from an academic issue to one that is politically 'hot,' then scientific uncertainties suddenly takes on political significance, the incentives to air scientific disagreements publicly are greatly amplified, new research may be undertaken that reveals new uncertainties or questions, and scrutiny of scientific results by both professionals and laypersons increases. Consensus is therefore much more difficult to achieve than for an issue that nobody outside of the laboratory cares much about (Sarewitz 1996, 58).

In this kind of situation, the most reasonable and effective path to a decision that can be legitimated as "scientifically sound" is for scientists to be willing to engage in negotiation over their differences.

To some, this may sound unscientific and even unethical. How can we negotiate over truth or facts? The answer to this concern is that where there is nothing approaching a scientific consensus, there is not yet any established truth or fact. So, the next best thing, and, more importantly, the most scientifically sound thing to do, is to get the experts in a room to see if they can come up with the most likely approximation of the truth. In effect, negotiation, a concept

that would seem antithetical to the scientific method, is our only hope of establishing a scientifically legitimate base of knowledge for policymakers to use.

2) Boundary Work. Legitimating the science in regulatory politics also requires identifying what will be the work of the scientists and what will not. Again, to some, this might seem straightforward. But values questions are not so easily de-tangled from scientific ones. If we are concerned about exposure to some substance we suspect might be a carcinogen, we want to know what would be a "safe" level of exposure. The problem is that "safety" has both a scientific and a values component. It requires both a factual and a normative determination. A boundary, even if it is an arbitrary or seemingly artificial one, has to be drawn between what part of this question will be decided by scientists and what part will be decided by a participatory process of some kind.

Jasanoff (2005, 26) refers to this task as "boundary work" and defines it as "the creation and maintenance of essential social demarcations." Explaining the need for this work at EPA, she argues

> EPA was committed by law and cultural tradition to making rational decisions, and for the American public rationality meant that science should be kept distinct from politics and policy. Public confidence in regulation depended in part on the preservation of clear boundaries between scientific analysis and political judgment, a goal that risk assessment seemed chronically unable to meet. Attempts to restore the boundaries therefore became an integral part of environmental decision making (Jasanoff 1992, 207).

So, how do we draw these boundaries in the regulatory process? The answer to this question is not entirely clear but it seems that there are two rules of thumb. First, it is best to get this boundary work done as early as possible. It is not so much that there will be a meeting called the "boundary work" meeting in practice but, rather, that important decisions need to be made about what science advisers will and will not do, what kinds of questions they will and will not answer

and what kinds of recommendations they will and will not make. A second rule of thumb is that these boundaries should be negotiated both among scientists and others involved in the rulemaking process. Boundaries should not be established by scientists alone nor should they be imposed on scientists without their input. The bottom line is that the more consensus that can be reached early on about the line between science and the rest of the policy decision making process, the greater the legitimacy of the resulting rule.

> By drawing seemingly sharp boundaries between science and policy, scientists in effect post 'keep out' signs to prevent nonscientists from challenging or reinterpreting claims labeled as 'science.' The creation of such boundaries seems crucial to the political acceptability of advice. When the boundary holds, both regulators and the public accept the experts' designation as controlling, and the recommendations of advisory committees, whatever their actual content, are invested with unshakable authority (Jasanoff 1990, 236).

Applying the Model to Marine Protected Areas

The MPA question is fertile ground for studying this question and applying this model for two primary reasons. First, and most importantly, the MPA process in the National Marine Sanctuaries is currently the most forward pushing regarding alternative approaches to rulemaking. This, in part, may be explained by the relative insulation the agency enjoys. Though the specific sanctuaries enjoy high visibility in their regions, relatively few people are aware of the agency's mission. Second, the question of Marine Protected Areas is increasingly important both as an ecological tool and as a policy response. President Clinton's 2000 Executive Order 13158 on Marine Protected Areas established a federal priority for "an expanded and strengthened comprehensive system of marine protected areas throughout the marine environment" to "enhance the conservation of our Nation's natural and cultural marine heritage and the ecologically and economically sustainable use of the marine environment for

future generations." Similarly, several states have created state MPAs around the country. Among the most significant, California's 1999 Marine Life Protection Act (AB 993) requires the state to establish a master plan for the management of marine reserves and protected areas. Finally, MPAs provide a robust case study in that they bring together a wide variety of passionate interest based stakeholders. If commercial fishers, recreational anglers, and conservationists can work together in a facilitated process examining no-take zones, there is reason to believe that the process has potential for many other natural resource questions.

While each federal agency implements its own version of the process, the National Ocean Service within NOAA in the Department of Commerce has demonstrated a particularly effective model. Two of the National Marine Sanctuaries have taken on the question of Marine Protected Areas (marine reserves) through a process that goes much further to integrate the conflicting paradigms. Both the Florida Keys and Channel Island National Marine Sanctuaries have created a negotiated approach to rulemaking. The basic structure places the agency in the position of convener, with a stakeholder committee (referred to as a working group) made up of stakeholders and agency staff. In Florida, the stakeholder committee included scientists and engaged in a shared fact-finding process. In California's Channel Islands, the stakeholder committee was supported by two separate evidence panels -- an independent science panel examining the ecological utility of marine reserves in a narrow science based approach, and a "socio-economic panel" examining the economic implications. The primary goal of such an approach was to overcome the paradigmatic conflicts by linking stakeholder discussion to specific science based alternatives.

In Hawaii, a third, somewhat different process unfolded. The National Marine Sanctuary office established a single stakeholder group through the sanctuary advisory council to explore

the viability of Marine reserves in the Northwestern Hawaiian Islands. That process was replaced when President George W. Bush created the Northwestern Hawaiian Islands National Marine Monument as the world's largest fully protected marine protected area by presidential proclamation under the Antiquities Act. We outline this process in more detail below.

The Northwestern Hawaiian Islands

The ecological value of the Northwestern Hawaiian Islands, known since 2006 as Papahānaumokuākea, has been recognized as globally significant since the 19th century and was adopted as a World Heritage Site by UNESCO in 2010. Because the region is physically isolated with a limited history of fishing pressure, the area is near pristine. It includes the most isolated reef ecosystem in the world, 7000 species of terrestrial and marine animals – one quarter of which are endemic to the Northwestern Hawaiian Islands, and nesting grounds for 90% of Hawaiian green sea turtles (Pew 2006). The closest boundary of the reserve is approximately 150 miles northwest of Kaua'i, and includes 124 Islands and reefs that range over 1000 miles to the west. The Papahānaumokuākea marine environment is recognized as an apex predator dominated ecosystem (Friedlander and DeMartini 2002). While populations of top predators have declined by as much as 90% across the world's oceans, an estimated 54% of Papahānaumokuākea's fish are apex predators (Meyers and Worm 2003; Friedlander and DeMartini 2002). This is important because the quality of a marine environment is defined in part by the presence of large predators to keep trophic balance. Large predators maintain biodiversity by limiting the density of prey, enhancing the balance of lower trophic levels and reducing the likelihood of trophic cascades (Steneck 2012). Reserve managers have noted that large predatory fish that have been heavily depleted by fishing near populated shores are

abundant in the waters of Papahānaumokuākea. In addition, the reserve provides critical habitat for some 14 million seabirds and the critically endangered Hawaiian monk seal, of which only about 1200 remain (NOAA 2014).

The Papahānaumokuākea Marine National Monument in the Northwestern Hawaiian Islands constitutes the largest fully protected marine area in the world, encompassing 140,000 square miles. The Northwestern Hawaiian Islands has been of regulatory concern since 1909, when Theodore Roosevelt established the Hawaiian Islands Reservation as a preserve and breeding ground for native birds. As early as 1903 Roosevelt placed Midway under the control of the US Navy to protect seabirds that were being decimated for the value of their plumage to the high-fashion hat industry.[2] It is estimated that between 1897 and 1914 over 3.5 million seabirds were killed to serve the millinery trade, culling many seabird populations to the point of extinction (Spennemann 1998). The reservation was renamed the Hawaiian Islands National Wildlife Refuge in 1940.[3]

In 1996, President Clinton transferred Midway Atoll from the Navy to the US Department of Interior, renaming the reserve the Midway Atoll National Wildlife Refuge and giving the US Fish and Wildlife Service management authority. Under Interior, fishing in shallow areas with depths 60 feet or above was banned. However, there was resistance to banning fishing outright. Although existing permits allowed only a small fleet of eight boats employing less than 20 people, a ban on fishing was strenuously opposed by Hawaii Senator Daniel Inouye and NOAA's National Marine Fisheries Service (Pala 2006). In 2000, Clinton broadened the reserve to include the entire region by establishing the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve. This designation protected reefs and ordered the

[2] For more information on US occupation see http://www.fws.gov/refuge/Midway_Atoll/preserving_the_past/Chronology_of_Events.html.
[3] http://www.papahanaumokuakea.gov/management/wh_docs/ch5_screen.pdf

Secretary of Commerce to initiate the designation process to establish a National Marine Sanctuary to "ensure the comprehensive, strong, and lasting protection of the coral reef ecosystem and related marine resources and species (resources) of the Northwestern Hawaiian Islands."[4] What the Sanctuary designation would not do is ban all extractive activities. But, the momentum of the process was important. President Clinton was committed to expanding protection of the oceans, and his Secretary of Interior Brice Babbitt was committed to protecting the Northwestern Hawaiian Islands as a priority.

The executive order mandated the Secretary of Interior to create a Reserve Advisory Council (RAC) in accordance with the National Marine Sanctuaries Act. The RAC's jurisdiction was to provide advice and recommendations to NOAA on reserve operation and potential designation of the Reserve as a National Marine Sanctuary.[5] More importantly, it provided a vehicle to bring stakeholders together in a way that would allow their voices to become part of the institutional fabric of the management process. In 2000, NOAA's Office of National Marine Sanctuaries initiated a broad outreach process that resulted in a recommendation that the Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve be expanded and further protected as a National Marine Sanctuary. Between 2000 and 2005, NOAA conducted ten public scoping meetings and received 52,000 public comments (U.S. Fish and Wildlife Service and NOAA, 2007). NOAA also held meetings with the Reserve Advisory Council, partnering agencies, the Western Pacific Fishery Management Council, dozens of non-governmental organizations, and both consumptive and non-consumptive stakeholder groups.

By 2004, NOAA released its proposal to elevate Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve to a national marine sanctuary and published advice and

[4] Executive Order 76904
[5] http://www.papahanaumokuakea.gov/management/council/welcome.html.

recommendations for draft fishing regulations under authority of the National Marine Sanctuaries Act (NOAA 2004). In 2005, responding to wide public support and focused stakeholder petitions, Hawaiian Governor Linda Lingle signed a regulatory package that was considered pivotal in easing the federal gridlock.[6] Governor Lingle reversed the previous administration's pro-fishing position and mandated a ban on all extractive activities within the three-mile state water boundary of the Northern Hawaiian Islands region. The state protections established true ecological reserves and provided a model of what was possible for determining the standards for federal waters (Pala 2006). It is worth noting that opposition to an outright fishing ban was greatest among Democratic leaders, including Senator Inouye and Hawaiian Governor Cayetano, who feared that reserves designations were a slippery slope that would inevitably lead to fishing limits closer to the main Islands (Pala 2006, Revkin 2006a). Governor Lingle was Hawaii's first female governor, and Hawaii's first Republican governor in almost forty years. Lingle's willingness to adopt reserves was possible because she was not reliant on organized labor and was therefore able to split Hawaii's traditional Democratic constituencies. Finally, in April 2006, NOAA released the draft management plan for establishing the regulatory infrastructure of the proposed Northwestern Hawaiian Islands National Marine Sanctuary (NOAA 2006).

On June 15, 2006, regulators, fishing industry representatives, and environmentalists expected to hear President Bush announce the creation of the Northwestern Hawaiian Islands National Marine Sanctuary, the culmination of a decade-long process of politicking and negotiating, and the procedural conclusion of five years of NOAA's Sanctuary Designation process under the National Marine Sanctuaries Act. The Sanctuary designation would have

[6] Dominant stakeholder groups pressing for full protection included Kahea: the Hawaiian Environmental Allince, Hawaii Audubon Society, and Environmental Defense.

allowed NOAA's Office of National Marine Sanctuaries, in partnership with NOAA's National Marine Fisheries Service (NOAA Fisheries) and the State of Hawaii, to begin a year long process of establishing specific regulations balancing critical areas of protection with access and limited extraction. Instead, Bush surprised everyone by establishing the Northwestern Hawaiian Islands Marine National Monument through presidential proclamation under the authority of the Antiquities Act of 1906 (16 U.S.C. 431). The Marine National Monument designation brought much greater protection to the resource, establishing a complete ecological reserve that would ban all extractive activity within five years. The Monument was renamed Papahānaumokuākea Marine National Monument in early 2007, referencing the region's importance in native Hawaiian culture as the birthplace of all life.[7]

Management of the Monument is a cooperative agreement between several co-trustees, including NOAA's National Marine Sanctuary Program (NMSP), NOAA's National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (FWS), and the State of Hawaii. Access to the region is strictly controlled through a permit process for key activities. Non-consumptive Native Hawaiian cultural practices and research are the primary activities currently allowed in the Monument as commercial fishing has been banned since the five year phase-out ended in 2011. Non-consumptive recreational access such as diving and birding, is allowed only at Midway Atoll.

Discussion

[7] The naming of the monument is itself an example of the importance of stakeholder participation. The renaming occurred as an initiative of the Native Hawaiian Cultural Working Group, a subgroup of the RAC. http://www.papahanaumokuakea.gov/about/name.html

The first portion of this paper suggested that the tension between science and democracy in rulemaking can be reduced by engaging in widespread (but guided) participation, science advisors that work, and negotiation and boundary work.

Widespread (But Guided) Participation

Early Participation: The Northwestern Hawaiian Islands (NWHI) experience reflected many of the participation recommendations made earlier in the paper. Stakeholders were included early on in discussions of both the process and substance of establishing marine reserves. The initial process created the Reserve Advisory Council (RAC) for consultation and approval. The RAC itself is a stakeholder group made up of representatives from specific user interests. The RAC includes both community seats and government seats. Community seats include members and alternates representing Tourism, Marine Businesses, Non-Consumptive Recreation, Recreational Fishing, Commercial Fishing, Education, Research, Conservation, the native Hawaiian community, and two seats for Citizens-at-large. Non-voting Government and NGO seats include members and alternates representing the NOAA/Hawaiian Islands Humpback Whale National Marine Sanctuary, Marine Mammal Commission, National Science Foundation, U.S. Coast Guard, Department of Defense (USN), Western Pacific Regional Fishery Management Council, Department of the Interior (U.S. Fish and Wildlife Service), NOAA National Marine Fisheries Service, NOAA/Papahānaumokuākea Marine National Monument, and the U.S. Department of State. The diversity of stakeholder interests among the RAC seats ensured widespread representation within the convening agency.

Choosing Science Advisers: Science advisors and expert groups were assembled by the agency relying on both diverse representation from stakeholder groups, engagement with the

Western Pacific Regional Fishery Management Council (WPRFMC), Native Hawaiian cultural experts with expertise on indigenous fishing practices, regulators and policy managers from all agencies with jurisdiction in the resource, and members of the RAC (Kittinger et. Al. 2010). Implementing lessons from the Tortugas 2000 process in Florida, and the Channel Islands process in California, members of the expert groups were selected both based on the independence of their research agendas and on the jurisdictions they represented.

Finding Areas of Agreement Early: The facilitators were successful in guiding the stakeholders through several areas of agreement within the first several months. This was possible by keeping the RAC and expert groups working in a stepwise manner, where tasks could only be completed in a specific order. This precluded gaming behaviors by stakeholders by focusing discussion on discrete tasks. Ground rules were adopted early – including decision rules and processes to evaluate information sources. These early successes were critical for establishing mutual trust, and creating a sense of momentum. A consensus problem statement was created, defining discrete goals and objectives.

Top-Down and Bottom-Up Participation: The process employed both top-down and bottom-up participation. The question of establishing marine ecological reserves was initiated in 2000 when President Clinton issued Executive Order No.13158, mandating the creation of the NWHI coral reef ecosystem, and requiring formal stakeholder participation for the design of specific protections. The establishment of the RAC as the vehicle through which public participation would be organized – in addition to public scoping meetings consistent with the National Marine Sanctuaries Act – ensured that top-down design would not dominate. The process was well integrated with both top-down and bottom-up elements that tended to

complement one another well. Neither the agencies nor the stakeholders were in a position to capture the process.

Science Advisers That Work

Experience With and Understanding of Regulatory Science: The Northwestern Hawaiian Islands process was different than the stakeholder process in both Tortugas 2000 and Channel Islands. In the earlier processes, stakeholder participation was more central than in Hawaii. In the mid-1990s marine ecological reserves were still somewhat radical. The potential of stakeholders to veto a reserve process was high. The Tortugas 2000 model was instrumental in bringing stakeholders and science advisers into a linked process that allowed for shared learning. The Channel Islands process a couple years later similarly relied on stakeholder approval to make any meaningful movement. Because the Northwestern Hawaiian Island process was initiated by presidential proclamation, the reliance on stakeholders – though instrumental – was not critical to the designation. Unlike in Florida or California in the earlier processes, in Hawaii stakeholders understood that an ecological reserve was already the determined outcome – their role, therefore, was to influence the design of the reserve rather than decide whether a reserve would be established.

The key improvement of the Channel Islands process over the Tortugas process was the establishment of an autonomous stakeholder group which was independent of the science advisors. This was both a success, and a challenge. The science panel was fundamentally made up of university based marine scientists. It was clear early on that there was a distinct culture difference between the university scientists, agency staff, and stakeholders. The scientists were clear in their sense that if the agency would let them (e.g., do what they say) the scientists would

be able to solve the problem with some expediency. The scientists were at times frustrated by the agency staff's need to follow narrow technical guidelines and rules, and were dubious of stakeholders' abilities to put personal self-interest aside in the interest of building a viable reserve design. Staff and stakeholders, at times, interpreted the scientist's casual dress and flexible start times as a lack of commitment to the process. There was a gap in intercultural communications due to the lack of experience the university-based scientists had with regulatory science, and due to the lack of experience regulatory staff had with research scientists.[8] This created a modest amount of process drag, possibly explaining why some members of the stakeholder group felt that the science panel was aloof, or worse, dominated by ideologically driven reserve advocates.

In the NWHI process, stakeholders and scientists were individually empowered to contribute based on their expertise – creating a more collaborative shared learning (Bernstein, Iudicello, and Stringer 2004; Kittinger et. Al. 2010). It is likely that without the presidential proclamations, the shared learning between stakeholders and experts in Hawaii would have been much more similar to the occasionally antagonistic process in Channel Islands. In addition, the geography of the NWHI process was very different from the Channel Islands and Tortugas processes. As mentioned above, various fishing and recreation interests in Hawaii were more concerned with limitations on activities near islands from Kaua'i to the east. The threat to these interests was perceived as a "slippery slope" rather than the exact contours of the immediate no-take zone in question. This created a less conflictual process in which the RAC could work.

[8] Observations by Matthew Cahn in his role as chair of the Science Panel.

Early, Frequent, and Continuous Participation of Science Advisers: Clearly, the early, frequent, and continuous participation of all experts in the NWHI process was instrumental in creating both consensus-based data points (shared learning) and consensus-based shared values. Most observers conclude that the iterative process between expert groups allowed stakeholders to achieve a much higher level of technical knowledge and competency than would otherwise be possible. And, the independence of the stakeholder group allowed the process to avoid the problems associated with Tortugas 2000 -- including the lack of ownership expressed by some involved in Tortugas process. To that degree, the science advisers worked well.

Negotiation and Boundary Work

Negotiation: As we discussed earlier in the paper, regulatory science differs from research science in that regulatory science frequently operates in areas of greater uncertainty where this is less scientific consensus and there is often little time to wait for a scientific consensus to develop. As a result, a kind of scientific negotiation is sometimes needed in regulatory processes that requires agreeing on key facts, interpreting what the facts mean, and building predictive models. The NWHI process allowed scientists to engage each other in a meaningful way to get at that negotiated knowledge as it pertains to reserve design. But, robust debate and negotiation can only occur in an environment that is as de-escalated as possible. Scientists from different academic disciplines were able to engage each other over the meaning of different studies and infer how that data may align with habitat in the NWHI area. And, the integration of that data with the expert fishing groups and other stakeholder groups allowed a type of negotiation over scientific knowledge that included the public – something that was missing in both Florida and California. This can be problematic, as stakeholders will necessarily

ask questions from outside the paradigmatic boundaries of a given academic subfield. In the NWHI case, the politics were less polarized from the start and this allowed a better working relationship to emerge between all stakeholders and the scientists.

Boundary Work: The cooperation between scientists, cultural experts, fishing experts, and other stakeholders in the NWHI process was a key element of the success of the process. The primary reason for that cooperation was that the respective boundaries of the working group and the scientists was negotiated and made clear from the start of the process. Communication flowed relatively freely between the groups through formal and informal networks. Scientists held a series of informational briefings for stakeholders and the public, and sought to provide useful information to enhance the RAC's ability to understand the technical framework of reserve theory. By respecting the relevant boundaries, stakeholders were able to determine preferences and scientists were able to provide technical support in a successful partnership.

Conclusion: An Emergent Resolution?

In his recent, well-received book on why predictions are so often flawed, Nate Silver includes a chapter on climate change and on predictions about the consequences of climate change. The final section of this chapter is titled "The Difference Between Science and Politics," and Silver (2012, 410) says of science and politics, "What I do know is that there is a fundamental difference between science and politics. In fact, I've come to view them more and more as opposites." He explains that, "In science, progress is possible" because "science tends to move toward the truth" over time (Silver 2012, 410). "In politics, by contrast, we seem to be growing ever further away from consensus" (Silver 2012, 410).

The various processes utilized for the establishment of Marine Protected Areas provide

an optimistic counter-balance to the pessimism Silver expresses above. It is possible to have a democratic, political decision-making process that respects and even utilizes scientific expertise and knowledge. The NWHI process provided important direction to both state and federal regulatory processes. More importantly, the process yields useful lessons for future rulemaking in highly technical policy areas. The evolving model used in the Northwestern Hawaiian Islands was closer to resolving the paradigmatic conflicts between science and democracy than other approaches. The success of the RAC as a model and, specifically, the length of time the RAC had to allow for early participation, to allow for "scientific negotiation," and to build consensus among stakeholders was a key to the long-term legitimacy of the establishment of the largest marine ecological reserve in the United States.

Legitimating rulemaking in highly technical policy areas requires respecting two conflicting paradigms of legitimacy. Democracy and technocracy conflict in terms of who is authorized to participate, what method should be utilized to come to a decision, and the role of values, opinions, and preferences in coming to the "right" decision. A process that eases that tension can go a long way toward creating better regulatory outputs. The NWHI process was imperfect to be sure. But the resulting reserve design is stronger – and more sustainable – than a traditional regulatory process would have allowed.

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