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Knowledge in the policy process: Incorporating new environmental information in natural resources policy making

ROBERT G. HEALY[1] & WILLIAM ASCHER[2]

[1]*School of the Environment, Duke University Durham, NC 27708-0328 U.S.A.;* [2]*Sanford Institute of Public Policy, Duke University Durham, NC 27708 U.S.A.*

Abstract. Efforts by both natural and social scientists have brought significant new bodies of information to bear on natural resources policy making. Among these have been new insights in conservation biology and landscape ecology, new methods for valuing intangible resource benefits, and new frameworks for resource accounting. The use of these new sources of information is analyzed from a Lasswellian policy process perspective, with illustrations from recent experience with U.S. national forest planning. A distinction is made between the impact of new information on 'ordinary' as contrasted to 'constitutive' policy making. This experience suggests that these new sources of information may increase emphasis on sustainable, multiple benefit use of resources, but they can also shift power away from non-expert actors, undermine rights arguments, polarize debates over appropriate resource use, and delay timely decisionmaking.

Recent approaches to natural resource management have increasingly focused on the environmental side-effects of management decisions. It has been argued that current management of renewable resources, such as forests, recognizes only a narrow range of products as having value, and hence results in poor decisions (Hufschmidt, 1983; World Commission on Environment and Development, 1987; Repetto, et al. 1989). For example, forests are now discussed not only as sources of wood, but also in terms of their non-commodity values, such as protection of biodiversity, watershed functions, and carbon sequestration.

Believing that these non-commodity functions will be incorporated into public and private decisionmaking only if explicitly documented, natural and social scientists have been making strenuous efforts to better understand ecosystem functions, to quantify them, and where possible to incorporate them into the same valuation frameworks, such as cost-benefit analysis, used in public and private sector economic planning. These efforts have led to remarkable methodological improvements. Among them are techniques in conservation biology that have improved understanding of minimum populations of organisms necessary for survival, procedures in landscape ecology that spatially represent species inventories using geographic information systems, techniques for imputing market values to non-market commodities (notably contingent valuation, a survey method for valuing intangible benefits), and expanded systems of national and regional accounts that include a host of non-commodity system outputs.

It is widely believed, both by advocates of resource protection and by the researchers who use these new methods, that the new information will be a

great help in making natural resource policy. For example, Repetto et al. (1989: pp. 3–4) argue that when the depletion of natural resources goes unmeasured and is not taken into account in calculating national economic statistics (such as gross domestic product), current economic growth may appear to be misleadingly high because it cannot reflect the sacrifice of future growth potential entailed in the reduction of the natural resource base. Moreover, if forests are valued only as sources of timber, they will be liquidated far more rapidly than they would if other services, such as watershed and biodiversity protection, are explicitly taken into account.

Regarding the evaluation of natural-resource use and environmental costs of specific projects, Hufschmidt et al. (1983: pp. 1–2) argue that:

> it is of utmost importance that the effects on natural systems of development projects and programs be carefully analyzed. Such analysis is not a luxury, but must become an essential part of project formulation and evaluation if protection is to be provided to the natural-resource base that sustains human welfare.

They also point out that 'the great expansion in environmental and natural-resource economics has led to many applications of benefit-cost analysis and related techniques to the valuation of natural systems and environmental quality.'

Such attempts to generate and utilize more information in aid of natural resource policymaking appear to be motivated by several expectations:

(1) That better understanding of the multiple functions of ecosystems will lead to more attention to balanced conservation as a concern of public policy and to more support among policymakers for conservation. For example, it is assumed that quantification of the value of non-marketed forest benefits, preferably in dollar terms, will make it easier for protective policies to compete with alternative policies emphasizing timber harvesting and land clearing.

(2) That more information will lead to more rational decisionmaking by reducing uncertainty and giving more explicit weight to conflicting objectives.

(3) That more information will result in more knowledgeable and more responsible participation in policy debates by diverse interested parties.

(4) That more and better information will produce less conflict, and more consensus, in decisionmaking, at least insofar as conflict stems from disagreement over discernable facts. As a result, there will be an increased likelihood that conflicting parties will reach acceptable, verifiable, and enforceable agreements. For example, better knowledge of the minimum

land area requirement of an endangered species may lead to conpromise solutions on land allocation, whereas currently there are recurring clashes between development planners and environmentalists.

In this article we will explore the impact of scientific and economic information on the *process* of natural resource policy making. We will begin by considering the role that the accumulation of such information has played in long term planning for the management of national forests in the United States since 1974. Although massive amounts of new information were generated, and many of the most sophisticated new methods were applied to its analysis, including creation of a comprehensive framework for decisionmaking, many if not most of the expectations for improved policy making have not been realized. In seeking to explain why this was the case, we re-examine the case in the light of the Lasswellian model of the policy process. The result, we believe, is new insight into the actual role of information in policy making. To understand this role, as we shall see, it becomes particularly important to understand how individual actors in the policy process employ information to advance their interests and to distinguish between the impact of information on 'ordinary' policy making and its impact on 'constitutive' policy making.

Using information in resource policy making: National forest planning in the United States

The U.S. National Forests represent 191 million acres or about a quarter of the nation's forestland. Since the end of World War II there have been greatly increased demands by various users of these forests to provide higher levels of timber, wildlife, and recreational outputs. A visible increase in conflict among user groups has accompanied these increased demands. Particularly contentious have been the practice of clear-cutting of timber, building roads and logging in potential wilderness areas, and management of habitat for endangered species, such as the red-cockaded woodpecker and the Northern spotted owl, that require large tracts of old growth forest. Simultaneous to the increased demand and increased intergroup conflict has been a questioning of the heretofore accepted judgment of technocratic managers – the professional foresters employed by the U.S. Forest Service – in balancing competing demands.

By 1974, management of the National Forests was threatened with paralysis. Both recreational groups and the forest products industry were at odds with the Forest Service, and court decisions threatened to prohibit most timber harvesting in large regions of the country. The Forest Service and the congressional committees to which it is responsible searched for a way to resolve conflict and legitimize multiple use management. The result was a complex planning process, involving information gathering and plan preparation for the National Forest System as a whole, and for hundreds of individual

units. (For convenience, we will refer to the process as RPA/NFMA after two principal authorizing laws, the Forest and Rangeland Renewable Resources Planning Act of 1974 and the National Forest Management Act of 1976).

A major force behind RPA/NFMA was Senator Hubert Humphrey, at the time a member of the Senate Agriculture Committee, which has jurisdiction over the Forest Service. Humphrey, a fervent advocate of planning as a means of social reform, began the RPA/NFMA effort by introducing a bill (which became RPA) to require the Forest Service to prepare periodic assessments and management plans for the entire National Forest System. Detailed resource inventories were to be the basis for an assessment of the nation's forest and range resources, looking at supply and demand for various outputs a full 50 years into the future. On the basis of this objective information, the Forest Service would prepare a set of management alternatives for public comment and critique. Once an alternative had been selected, the Forest Service budget for the next five years would reflect the indicated investments and actions.

Senator Humphrey believed that assessment and deliberate planning was the solution to the political impasse then facing the Forest Service. 'The goal of this legislation,' he said, 'is to reform the way short- and long-term decisions are made by providing a comprehensive factual base for all who have to participate in the process.' Humphrey noted that there would be 'a wide range of views presented' and 'a constructive and healthy debate,' but he focused on the promise of objective information:

> If we all approach the task of charting the future with the national interest in mind, I have no doubt that we can chart a wise course. The subsequent budget process each year will benefit because we will be dealing with facts rather than fantasies and emotions (Congressional Record, 1974).

Optimistic expectations about the merits of information were also voiced by one of the Senator's principal staffers:

> The RPA will not settle existing conflicts, nor was it offered as a panacea. But the Act encourages a long view that will place the conflicts in a framework that is amenable to rational debate, rather than to the myopia that usually attends legislative crises or the troublesome dictates of federal courts (Giltmier, 1976).

The stated Congressional intent in the RPA was more modest and focused on the Congress' own responsibilities – the process was to obtain 'information that will aid Congress in its oversight responsibilities and improve the accountability of agency expenditures and activities.'

The RPA/NFMA process proved to be a prodigious generator of information. The national level planning effort featured a detailed assessment of supply and demand for various forest outputs, while local plans were pre-

ceded with an analysis of the local 'management situation.' National plans were prepared in 1975, 1980, 1985 and 1990. Each time the informational basis for decisionmaking improved. For example, the 1975 assessment provided much greater detail on timber outputs and values than on other resources, such as recreation and wildlife. As a result, Forest Service researchers were directed to devise better analytic methods and to collect more data on non-timber forest outputs. By 1990, the Forest Service was able to publish a document that provided output levels, and imputed dollar values, for all of the major forest outputs: timber, water, recreation, wildlife, minerals, and grazing. Although there are major methodological problems remaining, it is indisputable that the informational basis for decisionmaking about the National Forests is incomparably better than that in 1974 and earlier. How has this information affected decisionmaking, and what might we learn about how information circulates in this particular policy process?

Among the most striking results was that added information about the state of National Forests helped make possible the use of formal decision models, in this case an elaborate linear programming model called FORPLAN (from FORest PLANning Model). In 1979, the Forest Service designated FORPLAN as the 'required analysis tool' for forest planning (Iverson and Alston, 1986: p. 14). FORPLAN was the successor to earlier timber models and watershed models, but it had the virtue of making possible the consideration of tradeoffs among a wide range of forest outputs. Because these outputs were measured in different units (e.g., acre-feet of water, cords of pulpwood, recreation visitor-days) elaborate valuation studies were conducted to reduce noncommensurables to a common unit, an imputed dollar value. FORPLAN fed off the information generated by RPA/NFMA, but it also affected the type and information generated. For example, qualitative information and information specific to local areas was less desirable than information that matched FORPLAN's output categories and areal units of observation.

'The agency's decision to implement FORPLAN,' says one observer, 'resulted in a considerably more mechanistic approach to planning than that required by NFMA. ... By choosing a linear programming model ... which used a constrained optimization technique to find the maximum NPV, the agency's forest economists indeed "promised more than they could deliver"' (McQuillan, 1989: p. 62). In fact, although FORPLAN optima figured prominently in Forest Service documents, they seem to have had little impact on either the ultimate planning decisions or on actual budget allocations to various activities.

The Forest Service planning effort did demonstrate how expensive it can be to generate and analyze information about complex and decentralized natural resource systems. Behan (1990) refers to the 'overwhelming cost' of doing the planning and analysis. Citing evidence from a government-sponsored study suggesting that the Forest Service was spending at least $ 200 million annually on RPA/NFMA planning, he notes that 'that figure makes the

cost of forest planning the largest single item in the national forest system budget, edging out, in fiscal year 1988, such historic and richly endowed programs as road construction ($ 171,764,000) and timber sales administration and management ($ 185,561,000).'

Although the framers of RPA/NFMA clearly hoped that it would have a major impact on decisionmaking (thereby justifying its cost) actual implementation of planning revealed that land use decisions by forest supervisors were frequently inconsistent with those pointed to by the FORPLAN analysis. For example, when Forest Service authorities in Colorado made decisions about wilderness designations, there was no significant relationship between official estimates of net present value and the actual wilderness recommendations by the Forest Service (Loomis 1987). Loomis invokes the theory of bureaucratic behavior, observing that 'until incentives are changed to make economic efficiency in the manager's self-interest, nothing more than "lip service" will be paid to economic efficiency' (Loomis 1987: p. 33). Sample (1990) makes a more general point:

> In the final planning decisions, forest supervisors were spooked by interest groups' sensitivity analysis, showing that quite plausible adjustments of imputed resource values and projections of real-term price increases for commodity resources could completely scramble their ranking of alternatives by NPV. So they backed off the analysis and largely made their decisions the old-fashioned way – getting the best available data on resource capabilities and then balancing the array of local needs with certain national priorities.

Moreover, factors entirely outside the formal planning process were important, even decisive, when decisions were eventually made. Sample (1989) emphasizes the role of the federal Office of Management and Budget (OMB) in turning Forest Service plan recommendations into actual line items in the federal budget. Despite the Forest Service's systematic analysis, federal budgets (and actual Congressional appropriations) for specific forest resources (water, timber, recreation) have rarely met Forest Service recommended targets. Sample notes that although Congress specifically rejected an OMB set of alternatives for the 1980 RPA in favor of Forest Service RPA alternatives, actual funding for Forest Service programs during the subsequent years was much more consistent with the OMB alternative that with that of the Forest Service.

OMB intervention to underfund Forest Service programs is clearly related to the growing federal budget deficit and resulting keen competition for federal dollars. But it also reflects differences in philosophy and analytic approach. Sample observes that OMB faults Forest Service analysis, rather than ignoring it. In particular, OMB would like more analysis of marginal benefits relative to marginal costs of small incremental expenditure changes, rather than the large incremental increases typically proposed by the Forest

Service. 'It is felt,' says Sample, 'that Program alternatives always shoot far beyond [the point of intersection of marginal cost and marginal benefit] and that lesser increments are not adequately evaluated' (Sample, 1989: p. 22).

Another lesson from the RPA/NFMA process is that the sustained, systematic commitment of resources to a purpose consistent with long term plans may be incompatible with the need for decisionmakers to respond to changing social needs and political pressures. Sample (1989: p. 21) observes that the five year funding commitments called for by RPA/NFMA do not fit well with the President's need for flexibility in responding to shifting budget needs and priorities.

Information generated in the RPA/NFMA planning process was used not only by the agency charged with making resource decisions, but also independently by various interest groups. For example, the Wilderness Society, a nonprofit group interested in increasing the proportion of federal lands set aside as wilderness (where logging and motorized recreation are prohibited) published a series of national and regional critiques of the Forest Service's plans. These critiques highlighted such features as the large planned increase in road construction and the low revenues forecast to be obtained from some timber harvests while citing and recombining Forest Service data to make its points (Wilderness Society, 1987; Jackson, 1989). The Society employed Ph.D. level economists and professional planners and policy analysts in order to legitimize its analysis. The forest products industry, working through several trade associations and lobbying groups, has also made extensive use of RPA/NFMA data and analyses, particularly data showing future shortfalls in softwood lumber output. Like the Wilderness Society, the industry has also employed expert analysts. For example, an industry group distributed an analysis by a Michigan State University professor (Chappelle, 1990) that questioned the technical basis of Forest Service valuations, particularly those resulting in high levels of 'social benefits.'

The information generated by RPA/NFMA and the powerful analytic tools that were developed to analyze it might have been expected to increase the legitimacy of the Forest Service as a decisionmaker. Indeed, although the Forest Service presented eight to eleven 'management alternatives' to public scrutiny in various national and forest-level plans, there was more detailed and comprehensive analysis of the 'preferred alternative,' that is, the one recommended by the Forest Service. This alternative was often very close to the existing management emphasis. Differences frequently pointed in the direction of increasing the outputs of nearly all forest products and services through additional appropriations to the Forest Service. Such Forest Service maneuvers were never really effective. One reason was the ability of environmental and industry groups to hire their own experts and expose hidden assumptions and agendas of the Forest Service. Another reason was that the FORPLAN effort was so technically opaque to politicians and local interests that it tended to confuse rather than impress.

McQuillan (1989: p. 71) notes that the intent of RPA/NFMA was 'a resto-

ration of public trust.' 'By the sensitive application of rules of reason exposed to public scrutiny,' he writes, 'Congress hoped that the agency would demonstrate the reasonableness of its management decisions to a skeptical public and, consequently, restore public trust in the management professionals.' But, according to McQuillan the Congressional invitation to restore its legitimacy was taken up by the agency as a technical planning mandate:

> it appears that the designers of the forest planning process never recognized this need [to restore trust]. Instead, they perceived an overriding need to determine the optimal, socially efficient forest plan. ... [T]hey adopted a sophisticated 'black box' model (FORPLAN) which is not only inaccessible to many of the agency's own professionals, but also beyond the general reach and scrutiny of an intelligent public.

In the final analysis, the elaborate data gathering and planning process that Senator Humphrey believed would replace 'fantasies and emotions' with 'facts,' has so far not created consensus on management directions. As of early 1990, 14 years after passage of the NFMA (which had mandated completion of individual forest plans by 1985) 92 of the 94 completed forest plans were under formal appeal (Behan, 1990). Five plans were in the courts, one had been declared illegal, and the others were in the administrative appeal process. There were 332 active appeals, brought by conservation organizations, timber and mining industries, off road vehicle interests, state and local governments, Native American interests, and private citizens (Behan, 1990). Clearly the avalanche of information and analysis afforded by RPA/NFMA did not bring the interests to easy agreement, nor did it replace political conflict with a reasoned search for optimality.

A more recent controversy over national forest management involves new ecological information, and a sophisticated system for dealing with it. This is the controversy over management of old growth timber stands in the Pacific Northwest.

During the late 1980s and early 1990s, a new type of information began to influence thinking about natural resource management and to infiltrate Forest Service planning. This was the new insights derived from conservation biologists regarding the genetic requirements for preservation of viable populations of specific organisms. Even under conditions of absolute protection, scientists asserted, areas that were too small to support a minimum-sized population of an organism were doomed eventually to lose it. (Reasons for species loss include inbreeding and genetic drift, among other causes.) Ecologists began to offer scientific arguments for management of extremely large areas in ways that would permit a sufficiently large number of individuals of endangered species to intermingle and hence to have the genetic opportunity for survival. For species that require large areas per individual (or breeding pair) such as the federally protected grizzly bear, Florida panther, red-cockaded woodpecker, and Northern spotted owl, these areas could be large

indeed. Moreover, the woodpecker and owl were believed by ecologists to require large, old trees for breeding cavities and to be intolerant of nearby disturbance of vegetation. This had the effect of putting some of the most valuable old-growth forest land (or in the case of the woodpecker, mature southern pines) off limits to timber harvest. The new ecological information became available at about the same time that advances in computer technology made it possible to produce elaborate maps of areas where management was potentially limited by the requirements of particular species. An entirely new approach to resource management at large scales, often called 'ecosystem management,' began to influence thinking about natural resources.

This new knowledge has recently been put to use by the U.S. government in dealing with the thorny issue of how to manage old growth conifer forests in the Pacific Northwest, in the context of protecting the Northern spotted owl and the marbled murrelet. The issue, which has been brewing for many years, pits advocates of protection of the old growth ecosystem (much of which occurs on National Forest land in Oregon, Washington and California) against timber companies, loggers, and logging-dependent communities. In April 1993, newly elected President Bill Clinton, convened a 'Timber Summit' in Portland, Oregon, in an attempt to strike a balance among competing demands and to create a consensus management plan for the affected National Forests. The Summit itself did not result in a settlement, but was followed immediately by appointment of an interagency group, the Forest Ecosystem Management Assessment Team (FEMAT). The group was composed primarily of scientists from federal land management agencies, with considerable input from university scientists. The methodologies used were very reminiscent of RPA/NFMA, but with the addition of many ideas from 'ecosystem management.'

Like RPA/NFMA, FEMAT resulted in nine management options, each with an associated level of timber cut, species protection, and timber industry employment (Thomas, 1994). Unlike RPA/NFMA planning, the task force produced its analysis and recommendations within three months. On July 1, President Clinton announced that he had selected Option 9, the option recommended by the Task Force. This option provides for a set of corridor linked old growth forest reserves (for species and ecosystem protection) but releases land outside the reserves for logging.

It is simply too early to tell whether this new attempt at knowledge-based decisionmaking will fare any better than RPA/NFMA in producing rapid, rational, and widely accepted decisions. However, the initial signs suggest that many of the RPA/NFMA problems are arising in this case as well. In April 1994, the *Journal of Forestry*, organ of the Society of American Foresters, published a special issue on FEMAT. The issue contains descriptive and analytical articles about the FEMAT options, but is also interspersed with critical commentaries from a variety of interest groups. They do not indicate that consensus has been reached. The co-chair of an Oregon environmental group criticized Option 9 as 'scientifically unsound, ecologically perilous, and

legally indefensible' (Wales, 1994). A professor of sociology, commenting on the social impact portion of FEMAT observed that 'when measured against [social impact assessment] standards, my judgment is that the social impact assessment of FEMAT is not "scientifically sound" ' (Gale, 1994). An economist concluded that 'Overall, the FEMAT report either ignores large and tangible economic losses or masks them by claiming dubious economic benefits' (McKillop, 1994). And an executive of Potlatch Corporation observed that 'I find little in this report to suggest that Option 9 will lead to the kind of solution President Clinton requested' (Newberry, 1994). Perhaps most telling is the fact that a coalition of 14 forest products trade associations filed suit in federal court, charging that the FEMAT process violated the Federal Advisory Committee Act, including its provisions against secrecy and the requirement that the advisory group be fairly balanced in points of view represented.

In introducing the *Journal of Forestry*'s treatment of FEMAT, two forest experts who were themselves members of FEMAT (Shannon and Johnson, 1994) concluded with a statement that summarizes the difficulties in dealing with political problems through knowledge-based planning:

> While some may have hoped that the scientists on the FEMAT could solve the problems associated with management of forests in the Pacific Northwest, this is not the case. Rather, as the report's conclusion suggests clearly, the work of that team of scientists is done and the work of the political process has just begun.

Knowledge and the policy process

The recent history of national forest planning in the U.S. seems to confound the expectation that more knowledge about a given natural resource, even when explicitly packaged to aid decisionmaking, will lead to greater rationality, more consensus, and speedier decisions about its management. Why is this so? We believe that the answer lies not in any fundamental inadequacy of the new methods (e.g., that the new information was incorrect or irrelevant) but in lack of understanding of how knowledge is incorporated in real-world policy making.

A fundamental axiom of the policy sciences is that policy is made not by a single decision or a unitary decisionmaker, but by a multi-stage process in which contending interest groups or stakeholders attempt to advance or to protect their interests and preferences (Lindblom, 1980; Brewer and deLeon, 1983; Stone, 1988). It should not be surprising that the facts that motivate decisionmaking are incorporated in this process and are actively used by the interests that participating in it. Moreover, increased amounts of information, whether economic, biological, or some synthesis of the two, are not only incorporated into the decision process but *affect the process itself.* Some of the possible effects may actually weaken the input of those concerned with

resource conservation, even when the information itself tends to support their cause.

The policy process has a prodigious appetite for information. This appetite exists, however, not only because participants believe that better information results in 'better' policy, but also because the possession of information can confer political advantage. The quest for political advantage tempts groups to exaggerate or distort information and often gives wide circulation to information of poor technical quality when that information serves to support the interests of one group over another. In this process, information is not neutral in terms of the power relationships or institutional structures.

While the 'information is power' principle has been widely recognized (Brewer and deLeon, 1983: ch. 7), the national forest planning case points to a less obvious but equally important principle: *The availability of information can have a profound impact on the selection of analytic techniques and the decision rules that determine natural resource policy.*

In understanding how changes in the nature and volume of information shape policy making, it is helpful to utilize Harold Lasswell's distinction between 'ordinary policy making' and 'constitutive policy making.' Ordinary policy making is the deliberation over substantive policy choices within a *given* structure or context of what people want and how policies are viewed as legitimately made (Lasswell, 1971: p. 77). Constitutive policy making comprises deliberations and choices regarding *how* policy should be made and, by implication, *who* ought to be involved in choosing policies. Constitutive policy making theory goes beyond the everyday operation of the existing policy process to focus on how the institutions, analytic techniques, procedures and people involved ought to be structured or selected (Lasswell, 1971: pp. 77, 98–111).

Impact of environmental information on the ordinary policy process

The ordinary policy process is affected in several distinct ways by changes in the availability of information about natural resources. First, as anyone interested in the general quality of the decisionmaking process would hope, valuation and inventorying can expand the range of considerations at the focus of attention of policymakers, enabling them to examine tradeoffs more comprehensively. The main virtue of valuation is that it allows for the expression of tradeoffs in consistent and comparable terms, as all valued outputs are monetized. Therefore comprehensive valuation reduces the risk that relevant values may be overlooked because of the absence of information that would evoke the mobilization of those values.

Second, greater information is likely to alter the intensity of demands that relevant actors will make in the natural resource debate. The enormous efforts of conservationist groups to generate information (both inventorying and valuation) for endangered populations and environmental risks can

strengthen support for conservation if knowledge of what would be jeopardized by resource exploitation mobilizes forces on the conservationist side. For example, the cataloguing of tropical plants and animals of medicinal potential may induce an active role by the pharmaceutical industry in protecting sources of biodiversity. Similarly, the tourist industry may become involved to defend an ecosystem that attracts tourists. The presumption is that credible, well-publicized inventorying and valuation will increase the *awareness* of risks and the *political pressure of mobilized interests.*

Third, in providing information for planning, the combination of inventorying and valuation also provides a vital part of the information necessary for *ex post* evaluation of the impact of policies. This would tend to make the net impacts more transparent and would make policymakers more accountable for the decisions that they make. For example, the inventorying and mapping of endangered species habitats is likely to increase the demand that Forest Service policies take them into account *ex ante*, and also provides a baseline for *ex post* evaluation after the policy has been carried out.

However, accurate inventorying and valuation do not necessarily favor the conservationist position. Rather than swaying key actors in favor of conservation, it is possible that clarifying the stakes may simply crystallize existing preferences and polarize the confrontation between conservation and resource exploitation. Consider, for example, the discovery that a large number of red-cockaded woodpeckers (a federally listed endangered species) live in a particular forest area and would risk extinction if logging were permitted. It is possible that some officials or citizens who were previously unaware of the woodpeckers or of their vulnerability would now side with the conservationists. But it is also possible that the pro-logging advocates put so little value on the preservation of the birds that their views do not change at all. Even a good inventory and valuation will not necessarily be accepted as such by all actors. There is an unavoidable degree of arbitrariness in establishing its terms and framework, particularly in the valuation stage.

Moreover, even highly accurate information on the magnitude of resources will be interpreted by each actor according to his or her differential weighting of the importance of that resource. Even if the census of red-cockaded woodpeckers is conceded by all to be rather accurate, the valuation of the birds, inevitably a function of preferences and values, may be highly controversial.

This may tend to increase differences in preferences and interests, rather than promote consensus. For example, knowing that the forest has precisely 85 important plant and animal species and precisely 2.5 million cubic meters of marketable timber does not necessarily draw the actors concerned about biodiversity closer to those concerned about timber exploitation. Presumably, demands to exploit will be heightened if greater volumes of the exploitable resource are found. Demands to preserve may be heightened either if the number of affected species is found to be greater than believed, or if the populations seem to be in greater danger of extinction. This simply demonstrates that while the scenario of more precise information leading to con-

vergence of policy preference may be possible (for example, an economically exploitable resource may be shown to be less promising, and the potential environmental damage greater, than previously thought), it is not a logically more likely outcome than the scenario of more polarized preferences. The net effect of the information and the valuation effort may be to polarize the positions, without contributing greater responsibility, balance, or consensus to the formulation of resource management policy.

It is also possible that the inventory may not come up with such an impressive number (or variety) of natural assets. The defender of red-cockaded woodpeckers or Northern spotted owls may consider that any number of individuals of those species is worth saving, but if the inventory determines that the area in question is not particularly suitable as their habitat, the inventory may weaken the conservationists' position.

Impact of environmental information on the constitutive policy making process

Thus far we have outlined how environmental information, if added to an existing policy making process, can affect the intensity of demands, the possibility of gaining adherents for conservation strategies, and the possibility of polarization whether or not the structure of the policy process changes. In this section, we examine how new information can change the process itself, and the implications of those changes.

These process – in Lasswellian terms, 'constitutive' – changes include:

- demands for greater use of explicit cost-benefit or optimization routines;
- changes in the arenas in which decisions are made;
- changes in the relative power of political and bureaucratic institutions;
- changes in the skills required for actors to be effective in influencing policy in the relevant arenas;
- changes in the values that gain or lose legitimacy and therefore in the types of arguments that are seen as most legitimate and persuasive.

Demands for explicit cost-benefit or optimization routines. The most central impact to be expected from the introduction of inventorying and valuation into the natural resource policy process is the greater dominance of technical analytical routines that can utilize this information. Since 'technical analysis' is only one informational input in the policy process, it competes with expressions of opinion and interests from non-technical sources in molding the focus of attention and the decisions of policymakers. As technical analysis becomes more prominent, and is perceived as more substantial, it may squeeze out other forms of information, decisionmaking routines, and claims.

It is reasonable to assume that the existence of credible natural resource inventories and valuations will increase the demands that project and policy evaluations use these valuations in an explicit, integrated way. A latent demand often exists for explicit decision-making aids that seem to generate

precise, objective results, if only sufficient informational inputs were available. The actors capable of operating and shaping the results of these decision aids have an obvious incentive to implement them once the necessary inputs are available (Ascher, 1978; Brewer, 1973; Greenberger, Crenson and Crissey, 1976). Moreover, if such information is available, decision routines that do not incorporate the information run the risk of losing credibility.

As the national forest planning case shows, natural resource inventorying and valuation constitute a major source of model-driving information and analysis. The information generated in the RPA/NFMA process, for example, was not simply the outgrowth of the data needs of the Forest Service's FORPLAN model; it was also a rationale and a prod for developing the FORPLAN model. Valuation is also a necessary input for credible cost-benefit analyses for *ex ante* project evaluation of ventures that affect natural systems, and for natural resource accounting. Once this information is available, the corresponding decision aids come to be seen as both more feasible and more compelling.

Arenas, influence, and skills. When explicit policy assessment routines are adopted by government agencies and become prominent in the decision process, policy deliberation tends to become more confined to actors within the government, and particularly to the technical experts and top-level decision-makers within that government. Government officials are confronted with multiple environmental and developmental demands; a single routine that can claim to take account of all the 'relevant' information can preempt further pressures on the government. The capacity to bring information and an objective function within a single decision algorithm often increases the legitimacy, feasibility, and weight of the 'internal' decision, in contrast to the situation in which all interested parties debate and agitate for their preferred outcomes – each using a different set of less formalized empirical assertions, demands and principles.

Once such a routine is legitimated within government, the internal actors may assume that the valuation fully captures the input of other interested actors. Indeed, this is the fond hope of government resource-management agencies, because it would tend to reduce the legitimacy of disagreement with the government's policy by non-governmental actors. Often the capability to make decisions based on what the government officials perceive to be sufficient 'objective information' leads to a dismissive attitude toward the 'subjective' viewpoints of others.

Bringing the decision more fully within the 'algorithm' also can change the weighting of the values represented by the insiders and outsiders. Even when authoritative and accurate information is incorporated into the model, model operators have insider access to the assignment of weights of relevant considerations and objectives. Conservationists may wish everyone to know about the large number of unique or endangered species, but if this number is used in a 'complete' analysis undertaken by analysts who attribute a low

weight to biodiversity preservation, then the political force of the information may erode. The conservationists cannot argue that biodiversity had been ignored; they can only argue (assuming that they can actually determine and demonstrate that biodiversity has received a low weight) that the weight is too low, an argument that cannot be made 'objectively' because values are intrinsically subjective.

The use of formal valuation techniques would seem to contradict this last point. If one takes the appropriate value of a given objective to be whatever 'the people' regard it to be, gauged by valuation methodologies (such as contingent valuation or hedonic pricing) that faithfully reflect people's preferences, then values that by their very nature are subjective are nonetheless objectively measurable so as to be, in theory, beyond dispute.

But the problem is not whether subjectively-held values can be accurately determined; it is in the remaining and irreducible subjectivity of deciding on whose values will receive how much weight (Whittington and MacRae, 1986). As Norgaard (1989: p. 308) points out, valuation, whether based on prevailing prices or on contingent valuation, reflects the predominant values reflected in the market and in the majoritarian attitudes of the current generation. The enumeration of exact numbers and areas of endangered ecosystems does little good for the conservationists if their worth is determined to be minimal according to prevailing values reflected in market prices or the citizenry's unwillingness to sacrifice much for their preservation.

Furthermore, even if the government attempts faithfully to capture the weights that would be assigned by particular non-governmental actors, the expression of preferences and interests may be significantly truncated. Consider the implications of the use of contingent valuation, a technique that uses sophisticated survey instruments to determine the value placed on various resources by members of the public. From the government's perspective, contingent valuation may be a sufficient characterization of public preferences and interests. Therefore, once the government actors are satisfied that the contingent valuation is adequate – according to the government's standards – internal decisionmakers may regard additional input from non-governmental groups as extraneous, or even as unfairly biasing the weighing of preferences. In effect, determining interests and preferences may be regarded within government as the end of politics.

A similar truncation of roles may occur within government. Valuation that demonstrates either the potential of, or the threat to, a significant natural resource may well enhance the standing of the governmental agencies with the mandate to conserve that resource. There is little doubt that the discoveries of coastal and maritime fishing and aquaculture potentials, and the fragility of these resources, have strengthened the standing of fisheries agencies in many countries. Yet once a valuation of these resources is 'registered' within a natural resource account or decision algorithm, there would be the same tendency for a single framework claiming to incorporate all aspects of the issue to reduce the legitimacy of *further* input and demands on the part of other agen-

cies. In short, whichever bureaucratic unit controls the cost-benefit analysis (e.g., central budgeting offices, finance ministries, planning agencies) can more easily claim that the valuation allows it to incorporate the relevant considerations concerning forests, fisheries, water systems, and so on, without requiring further involvement of the agencies charged with implementing policies in these areas.

The relative importance and prestige of different *skills* may also be affected by the prominence of quantitative valuation and a quantitative framework to utilize it. The skills associated with measuring the natural resource endowment and manipulating relevant policy assessment models (e.g., economists, biologists, and specialists in geographic information systems) will count for more than the skills required for interpreting the meaning of the natural resource endowment and the society's relationship to it (e.g., generalist land managers). Certainly this has been true in the U.S. Forest Service, where RPA/NFMA brought new influence to economists and FEMAT increased the input of biologists and ecologists. This is in contrast to the more open, varied-input debate over what to make of the *complexity* of the natural resource endowment when it has not been reduced to a small number of numerical aggregates. Specifically, technical valuation probably strengthens the hand of economists, and their values (e.g., concern for economic efficiency and an emphasis on discounting future costs and benefits) tend to be given added weight.

Various interests that might be threatened by exclusion from the debate because of the adoption of valuation may react by developing the needed skills. For example, they may hire economists, biologists and modelers of their own, as both conservation groups and logging interests have done in response to the increasing technical basis of Forest Service decisionmaking. This obviously puts some interests at an advantage over others insofar as the resources needed to make these adaptations are not equally shared. National interests would probably benefit more than local interests; the business sector more than non-governmental organizations, and so on.

Legitimacy of the assertion of rights. Valuation *per se* and the increased likelihood of a quantitative framework to incorporate it may also undermine the legitimacy of certain values asserted by actors interested in changing the existing structures and priorities. A 'right' is most usefully defined as a demand that is not conditioned by the net benefits associated with its fulfillment (Ascher and Brewer, 1988: p. 221). To assert that a species has a right to survive (whether literally as a right of the species or a right of future human generations to enjoy the existence of that species) is to assert a principle of the irrelevance of the weighing of costs and benefits. The assertion of rights to preserve species, protect plants and animals, leave ancient cultural artifacts untouched, or preserve existing fragile ecosystems are really assertions that normative principles hold prior to, and at least partly independent of, the calculation of costs and benefits. Thus, if one accepts these *as rights*, they

become constraints on the social welfare function, not grist for the optimization routines.

Many advocates of cost-benefit frameworks reject the assertion of rights as the last resort of the scoundrel who cannot justify his preference by demonstrating that society would be better off. Yet some bases for asserting rights are no less morally defensible than the cost-benefit framework. First, the rights position can be derived from the rejection of the anthropocentrism of cost-benefit analysis (Stone, 1974; Whittington and MacRae, 1986). Even the most sophisticated analysts simply do not know how to quantify either costs or benefits to non-human entities. Second, the rights argument can be based on the Kantian categorical imperative. Kant argued that the moral necessities arising from natural law must be observed regardless of the specific consequences of a particular action in conformity with such necessities. Finally, the assertion of rights may also be derived from the practical suspicion that the application of cost-benefit analysis will not truly reflect overall social welfare. If we accept the assertion of rights as a legitimate form of demand in the policy process, then the combination of valuation and a cost-benefit or resource accounting framework to incorporate the valuation would represent a threat to that form of demand.

Conclusion

Over the last two decades or so, there have been major additions to society's knowledge base regarding natural resources. This has included not only new data, but also new means of making measurements (remote sensing, contingent valuation) and new, more comprehensive decisionmaking algorithms. These advances have been accompanied by hopes that new knowledge would lead to resource policy decisions that would be more defensible, more widely accepted, and easier to implement. Sometimes these expectations have been met. Yet in other cases, as the history of knowledge-based management processes for making decisions about the U.S. national forests shows, these hopes have not been fulfilled.

As academics who are interested in, and value, these new data sources and techniques, we too are disappointed. But as students of the policy process, we are not surprised. In the policy process, information becomes raw material for use (and manipulation) by a host of self-interested actors, not an eagerly awaited source of consensus. Moreover, new information has the potential to change what Lasswell (1971) called 'constitutive' policy making, altering the very structure of the debate, the relative power of individual actors, and the strategies they will choose to seek advantage. New information may shift power away from non-expert actors, undermine rights arguments, polarize debates over appropriate resource use, and delay timely decisionmaking. Although new information may change policy outcomes, often for the better, there is little reason for believing that it will make the decisionmaking process itself either shorter or smoother.

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