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## **Policies for Risk Assessment in Federal Land and Resource Management Decisions**

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### **SUMMARY**

The National Fire Plan was developed to reduce wildfire risks on federal lands. Two environmental laws are based on risk assessment: (1) For any proposed "major" federal action, the National Environmental Policy Act requires consideration of "risk to health or safety, or other undesirable and unintended consequences" and documentation of short- and long-term environmental effects of management alternatives, including "no action"; some recent implementation modifications are intended to expedite hazardous fuel reduction projects. (2) Risk is central to implementing the Endangered Species Act. No federal action may cause "jeopardy" to protected species. Recent guidance documents revise procedures for addressing risk of hazardous fuel treatment projects during "jeopardy" consultation, and new regulations authorize "joint counterpart" consultation by agencies designing fuel treatment projects. Other policies requiring risk assessment include the Healthy Forests Restoration Act and proposed regulations for implementing the National Forest Management Act. The U.S. Environmental Protection Agency's *Guidelines for Ecological Risk Assessment* perhaps could be adapted to provide the required risk assessments.

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## Introduction

In early 2003, U.S. Senator Mike Crapo (R-Idaho) convened the Clearwater Elk Collaborative, a group of citizens interested in the management of elk in northcentral Idaho's Clearwater River basin. At the Collaborative's November 2003 meeting in Lewiston, following some debate several people requested additional information on risk assessment. This issue arose from an earlier presentation by the National Marine Fisheries Service about a new guidance memorandum encouraging the evaluation and balancing of short- and long-term effects of land management during the Endangered Species Act "jeopardy" consultation process.

The purpose of this issue brief is to explain that guidance and other related laws and policies requiring that risk be considered in natural resources management decisions on federal lands. These details are provided in subsequent sections. To understand these requirements, following is a brief overview of risk and risk analysis in a land management context.

### **What does "risk" mean?**

Risk is a concept used to give meaning to things, forces, or circumstances that pose danger to people and what they value (NRC 1996). For illustration purposes, simply consider that some "event" can physically alter human health or other things people value, including real property and intrinsic or non-monetary resource values. For example, a wildland fire can destroy human habitations and other structures, and also change vegetation patterns, with associated effects on wildlife habitat as well as landscape aesthetics and the quality of air and water. These are real, tangible effects that can be assessed objectively. However, our knowledge about the relationship between an event and its effects is often uncertain. Risk characterization also relies upon judgments about the likelihood or probability that the event will occur.

Risk thus has both real and imaginary components (Haines 1998). The concept of risk involves value judgments that reflect much more than just an event's probability and occurrence of consequences (Kunreuther and Slovic 1996). People have different perceptions about whether an event's effects pose danger or produce adverse effects.

### **Which laws and policies focus on risk?**

General requirements for analysis of risks and other environmental effects of management actions

are in the National Environmental Policy Act (NEPA 1969). Specific management considerations are those addressing wildland fire risks (National Fire Plan [USDA/USDI 2003a], Healthy Forests Restoration Act [HFRA 2003]) and the conservation of species-at-risk (Endangered Species Act [ESA 1973], National Forest Management Act [NFMA 1976]).

The remainder of this issue brief provides details on each of these. The **Conclusion** of this analysis is that federal land and resource management agencies, and regulatory agencies responsible for endangered species conservation, must use some form of risk assessment in their decision-making processes.

### **The "Process Predicament"**

Managing ecological risks depends on an integrated approach because risks arise from many sources—hydrologic, forest, rangeland, and aquatic as well as economic and social—and reducing risks from one source may increase risk to another ecological component (Quigley et al. 1998). Efforts to reduce the intensity and destructiveness of wildland fires have been hampered by administrative processes that have delayed crucial fuel-reduction projects. Such delays not only put communities and homes at risk, they allow the condition of key watersheds to continue to degrade (USDA/USDI 2004). In some situations federal land managers cannot take action to improve ecosystem health or meet their multiple-use sustained-yield mandates because of what has been characterized as a "process predicament" (USDA-FS 2002a). Policymakers recently have modified or "streamlined" some of the policies related to delays and inaction, including environmental effects analysis and interagency consultation to prevent "jeopardy" to species-at-risk.

### **Risk Assessment Procedures**

Risk analysis includes the interrelated phases of risk assessment, characterization, communication, and management. Although laws and policies require risk analysis, none of them prescribe how agencies should do risk analysis or what the end result should look like. Successful risk management depends on adopting an attitude that risk matters, and that more effective risk communications facilitate more effective risk management. Agencies could adapt the U.S. Environmental Protection Agency's *Guidelines for Ecological Risk Assessment* (US-EPA 1998) or, to address its deficiencies,

some other approach. I suggest starting with a simple conceptual model for comparing the magnitude of environmental risks and benefits associated with land and resource management projects over a time frame no shorter than 100 years (O’Laughlin 2003, 2004 a,b). More details are forthcoming in a PAG Report with the working title “Risk Assessment Primer for Natural Resource Managers.”]

## **National Environmental Policy Act**

The National Environmental Policy Act (NEPA 1969) is the cornerstone of environmental laws in the U.S.A. It requires that federal agencies consider short- and long-term environmental effects of proposed major actions, and document analysis of such effects. The basic purposes and requirements of NEPA are as follows:

[I]t is the continuing responsibility of the Federal Government to use all practicable means, consistent with other essential considerations of national policy, to improve and coordinate federal plans, functions, programs and resources to the end that the nation may – (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; (2) assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences; . . .

[NEPA] requires federal agencies to . . . include in every recommendation or report on proposals for legislation and other major Federal actions significantly affecting the quality of the human environment, a detailed statement by the responsible official on – (i) the environmental impact of the proposed action, (ii) any adverse environmental effects which cannot be avoided should the proposal be implemented, (iii) alternatives to the proposed action [including the alternative of no action (US-CEQ, 1978)], (iv) the relationship between local short-term uses of man’s environment and the maintenance and enhancement of long-term productivity, and (v) any irreversible and irretrievable commitments of resources which would be involved in the proposed action should it be implemented (NEPA 1969).

In NEPA, Congress established the Council on Environmental Quality (CEQ) to coordinate federal environmental efforts. One of the CEQ’s first tasks was to write regulations for implementing NEPA (see US-CEQ 1978). Although adverse impacts and

environmental effects are mentioned in the regulations, the term risk is not. Pertinent guidance states that when information is incomplete and uncertain, the environmental impact statement shall include, [T]he agency’s evaluation of such impacts based upon theoretical approaches or research methods generally accepted in the scientific community. For the purposes of this section, “reasonably foreseeable” includes impacts which have catastrophic consequences, even if their probability of occurrence is low, provided that the analysis of the impacts is supported by credible scientific evidence, is not based on pure conjecture, and is within the rule of reason (US-CEQ 1978).

NEPA assigns CEQ the task of ensuring that federal agencies meet their obligations under the act. The CEQ resides within the Executive Office of the President and works closely with all federal agencies in the development of environmental policies and initiatives. The CEQ chair serves as the principal environmental policy adviser to the president and oversees federal agency implementation of the environmental impact assessment process (US-CEQ 2003).

The NEPA process requirements for environmental impact assessment and documentation launched thousands of lawsuits that were not originally foreseen (Rodgers 1994). In 2002, the CEQ convened the NEPA Task Force to support federal agencies’ efforts to modernize their practices. Numerous parties have identified the need for greater efficiency and effectiveness in planning and decision making under NEPA, and to improve communications and collaboration between federal agencies and the public. The Task Force’s final report, released in September, 2003, contains recommendations to improve and modernize the NEPA process. A set of case studies highlighting useful practices will be published separately. The report’s recommendations are not mandatory, legally binding, nor considered as final agency action. The recommendations are a reference and resource for decision-makers and interested parties working to bring the NEPA implementation processes in line with 21st Century methods and needs (US-CEQ 2003). Actions to implement the recommendations may be expected in 2004 (D. Tenny, personal communication, 11 December 2003).

Meanwhile, using the President’s Healthy Forests Initiative (White House 2002) the Bush Administration has taken steps to establish a more effective and timely process to protect communities,

wildlife habitats, and municipal watersheds from catastrophic fires, including some refinements in the NEPA process, as follows:

- The Forest Service has implemented at least 46 high priority thinning and restoration projects using new NEPA procedures. The Bureau of Land Management is currently implementing more than 20 projects.
- The Departments of Agriculture and the Interior have improved NEPA environmental assessments (EAs) for priority forest health projects.
- The Forest Service and Bureau of Land Management have approved stewardship contracts using the new authority requested by the President and provided by Congress. Stewardship contracting will increase as NEPA work is completed in 2004. These contracts are a tool to restore landscapes, reduce hazardous fuel loads, and restore water quality and wildlife habitat (White House 2003).
- Two types of categorical exclusions from NEPA have been authorized: (1) for hazardous fuel-reductions activities that do not exceed 1,000 acres for mechanical treatments or 4,500 acres for prescribed fire, and meet a number of other specifications, including no projects in wilderness areas and no construction of new permanent roads; and (2) rehabilitation activities for lands and infrastructure impacted by fires or fire suppression, again limited by numerous specifications. Categorical exclusions are categories of actions which do not individually or cumulatively have a significant effect on the human environment and therefore normally do not require further analysis in either an environmental assessment or an environmental impact statement (USDA/USDI 2003c)

### National Fire Plan

Sound risk management is a foundation for all fire management activities (NIFC 2001). The National Fire Plan (USDA/USDI 2003a) is a policy consisting of various documents that represent the latest effort to address and reduce the risk of wildland fire on federal lands (US-GAO 2001). This plan, coupled with the Federal Wildland Fire Management Policy (NIFC 2001), forms a framework for federal agencies, states, native American tribes, local governments, and communities to reduce the threat of fire, improve the condition of the land, restore forest and rangeland health, and reduce risk to

communities (USDA/USDI 2004).

In total, the 655 million acres of federal lands represent 29 percent of the U.S.A. (Vincent et al. 2001). About 190 million acres of federal forest and rangeland in the lower 48 states face high risk of large-scale insect or disease epidemics and catastrophic fire due to deteriorating ecosystem health as well as drought (USDA/USDI 2004). As a result of fire exclusion, the condition of fire-adapted ecosystems continues to deteriorate; the fire hazard situation in these areas is worse than previously understood (NIFC 2001). The underlying cause is the buildup of forest fuel and changes in vegetation composition over the last century. Unnaturally dense stands competing for limited water and nutrients are at increased risk of unnaturally intense wildland fires and insect and disease epidemics (USDA/USDI 2004).

One of the Plan's objectives is reducing hazardous fuels (USDA-FS 2001). Researchers estimate that risks could be reduced substantially by restoring historic fire regimes on approximately 45 million acres of federal timberlands in the National Forest System. On almost half of this area, mechanical treatments such as thinning are needed before prescribed fires can be used (USDA-FS 2003a).

The Plan calls for actions that federal agencies, in cooperation with states and local communities, can take to reduce immediate hazards to communities in the wildland-urban interface area, and to ensure that sufficient resources are available and prepared for extreme fire conditions in the future (USDA-FS 2001). Federal and state officials have estimated that \$30 billion will be needed over the next 10 years to implement the Plan (US-GAO 2001). The Plan has five key features:

- Firefighting - Assure adequate preparedness for coming fire seasons.
- Rehabilitation and Restoration - Restore landscapes and rebuild communities damaged by wildfire.
- Hazardous Fuel Reduction - Invest in projects to reduce fire risk.
- Community Assistance - Work directly with communities to assure adequate protection.
- Accountability - Be accountable, and establish adequate oversight and monitoring for results (USDA-FS 2001).

The Plan requires coordination, consistency, and agreement among five federal land management agencies to develop an effective strategy to reduce the risk of wildland fire. Implementation will require

a full range of fire management activities, including management-ignited prescribed fires and other fuel-reduction treatments, such as thinning. Therefore, the policy requires an interdisciplinary approach in which federal fire managers must forge new working relationships with other disciplines within the agencies, including those responsible for wildlife and fisheries as well as vegetation and watershed management (US-GAO 2001).

The Plan significantly increases the national effort to reduce fire risk by treating hazardous fuels on a broad scale (USDA-FS 2001). Several other policies have been developed for implementing the Plan, including the President's Healthy Forests Initiative for Wildfire Prevention and Stronger Communities (White House 2002, 2003). The Bush Administration has several strategies for implementation (see USDA/USDI 2003). This paper only addresses those that specifically require risk assessment.

### Healthy Forests Restoration Act

The Healthy Forests Restoration Act (HFRA 2003) is the legislative component of the President's Healthy Forests Initiative (White House 2002), which is a strategy for implementing the National Fire Plan. Among other things, the HFRA requires courts to consider short- and long-term risk trade-offs before issuing injunctions stopping work on hazardous fuel-reduction projects or other projects designed to attain National Fire Plan objectives. This new law was signed 3 December 3 2003 and at this writing it is unclear what such risk trade-off analysis might look like.

The HFRA is the first major federal forest law in several decades. Among other things it authorizes the appropriation of \$760 million each year on activities and grants to reduce hazardous fuels on a total of 20 million acres of federal land using methods such as prescribed fire, wildland fire use, crushing, tractor and hand piling, thinning and pruning (USDA-FS 2003b). The HFRA is designed to accomplish the following things:

- Reduce dense undergrowth that fuels catastrophic fires through thinning and prescribed burns;
- Improve the public involvement in the review process by providing opportunities for earlier participation, thus accomplishing projects in a more timely fashion;
- Select projects on a collaborative basis

involving local, tribal, state, federal and non-governmental entities;

- Focus projects on federal lands that meet strict criteria for risk of wildfire damage to communities, water supply systems and the environment;
- Authorize the Healthy Forests Reserve Program, to protect, restore and enhance degraded forest ecosystems on private lands to promote the recovery of threatened and endangered species;
- Encourage biomass energy production through grants and assistance to local communities creating market incentives for removal of otherwise valueless forest material; and
- Develop an accelerated program on certain federal lands to combat insect infestations (White House 2003).
- Existing old growth management directions will be implemented, and review is required if such directions are older than 15 December 1993; and
- Projects in old growth stands should focus 'largely on small diameter trees, thinning, strategic fuel breaks, and prescribed fire...', and maximize retention of large trees (USDA-FS 2003b).

Specific to risk assessment, the HFRA addresses the implementation of hazardous fuel-reduction projects to reduce wildland fire risks and instructs courts to consider risk trade-offs before issuing injunctions on such projects:

TITLE I—HAZARDOUS FUEL REDUCTION ON FEDERAL LAND. Sec. 2. PURPOSES. The purposes of this Act are— (1) to reduce wildfire risk to communities, municipal water supplies, and other at-risk Federal land through a collaborative process of planning, prioritizing, and implementing hazardous fuel reduction projects; (2) to authorize grant programs to improve the commercial value of forest biomass (that otherwise contributes to the risk of catastrophic fire or insect or disease infestation) for producing electric energy, useful heat, transportation fuel, and petroleum-based product substitutes, and for other commercial purposes; (3) to enhance efforts to protect watersheds and address threats to forest and rangeland health, including catastrophic wildfire, across the landscape; (4) to promote systematic gathering of information to address the impact of insect and disease infestations and other damaging agents on forest and rangeland health; (5) to improve the capacity to detect insect and disease infestations at an early stage, particularly with respect to hardwood forests; and (6) to protect, restore, and enhance forest ecosystem components— (A) to promote the recovery of threatened and endangered species; (B) to improve biological diversity; and (C) to enhance

productivity and carbon sequestration. . . .

SEC. 106. JUDICIAL REVIEW IN UNITED STATES DISTRICT COURTS. (c) INJUNCTIONS.—(3) BALANCING OF SHORT- AND LONG-TERM EFFECTS.—As part of its weighing the equities while considering any request for an injunction that applies to an agency action under an authorized hazardous fuel reduction project, the court reviewing the project shall balance the impact to the ecosystem likely affected by the project of— (A) the short- and long-term effects of undertaking the agency action; against (B) the short- and long-term effects of not undertaking the agency action (HFRA 2003).

An interim field guide for implementing the HFRA and the Healthy Forests Initiative (USDA/USDI 2004) is designed to help managers identify the appropriate policy tools to match the management situation. It provides no guidance, however, on how to perform the risk analysis that courts need before considering petitions from plaintiffs to issue stop-work injunctions on hazardous fuel-reduction projects.

## Endangered Species Act

The Endangered Species Act (ESA 1973) is a broad and powerful law designed to provide protection for endangered and threatened species and their habitats through stringent mandates constraining the actions of private parties and public agencies (NRC 1995). According to a committee of biologists convened by the National Research Council of the National Academy of Sciences to examine and report on the biological science underlying the ESA, “The concept of risk is central to the implementation of the ESA. . . . The main risks are risk of extinction (related to the probability of both biological and non-biological events), and risks associated with unnecessary expenditures or curtailment of land use in the face of substantial uncertainties about the accuracy of estimated risks of extinction and about future events” (NRC 1995).

The NRC committee noted that “The terminology of the act implies that many decisions regarding conservation of species should consider estimates of extinction risk. Specific examples of such terminology include the definitions of endangered and threatened species, the provisions for removing species from the list, and the definitions of jeopardy on public lands, and taking on private lands” (NRC 1995). Specific mentions of risk in the act (ESA 1973) are as follows: The term

endangered species means “any species which is in danger of extinction throughout all or a significant portion of its range” (ESA § 3, Definitions). The term danger is closely associated with risk. The ESA in several places identifies provisions designed to prevent “significant risk to the well-being of any species of fish and wildlife or plants” including Determination of Endangered Species and Threatened Species (ESA § 4), Cooperation with the States (ESA § 6), and Penalties and Enforcement (ESA § 11). Most importantly, “Each Federal agency shall insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species” (ESA § 7, Interagency Cooperation). The term “jeopardy” is closely associated with risk.

The ESA identifies two regulatory agencies responsible for implementing the act: the U.S. Department of the Interior’s Fish and Wildlife Service and the National Marine Fisheries Service, recently renamed NOAA Fisheries because it resides within the U.S. Department of Commerce’s National Oceanic and Atmospheric Agency. These two agencies are often referred to in the ESA context as the “Service” or the “Services.” They are regulatory agencies because the ESA empowers them to design implementation procedures by following formal rule-making processes that result in administrative law codified in federal regulations. When action agencies, such as the USDA Forest Service and the USDI Bureau of Land Management, propose projects and activities in the vicinity of protected species, the Services are required to provide biological opinions about “jeopardy” (i.e., risk of extinction) and to ensure that such proposals do not adversely modify designated critical habitat. The process by which these biological opinions are developed is called consultation.

Section 7 of the ESA requires federal agencies to satisfy two standards in carrying out their programs (USDI/USDC 1998). Federal agencies must ensure that their activities are not likely to: (1) jeopardize the continued existence of any listed species, or (2) result in the destruction or adverse modification of designated critical habitat. The ESA requires federal agencies to confer with the Services on actions likely to jeopardize the continued existence of any species proposed for listing or result in the destruction or adverse modification of any proposed critical habitat (USDI/USDC 1998).

Jeopardy means further danger of extinction for species-at-risk. The term is defined in regulations, not statute: “‘jeopardize’ means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, number, or distribution of that species” (50 CFR § 402.02). The standard for jeopardy is that actions may not appreciably reduce the likelihood of species recovery. The Services’ *Consultation Handbook* states that,

Independent analyses are made for jeopardy when the species is present or potentially present, and for adverse modification when designated critical habitat is affected. . . . The determination of jeopardy or adverse modification is based on the effects of the action on the continued existence of the entire population of the listed species or on a listed population, and/or the effect on critical habitat as designated in a final rulemaking. . . . Adverse effects on individuals of a species or constituent elements or segments of critical habitat generally do not result in jeopardy or adverse modification determinations unless that loss, when added to the environmental baseline, is likely to result in significant adverse effects throughout the species’ range, or appreciably diminish the capability of the critical habitat to satisfy essential requirements of the species (USDI/USDC 1998, pp. 4-33 to 4-35).

Recovery means improvement in the status of a listed species to the point at which listing is no longer appropriate under the criteria set out in section 4(a)(1) of the ESA. Said another way, recovery is the process by which species’ ecosystems are restored and/or threats to the species are removed so self-sustaining and self-regulating populations of listed species can be supported as persistent members of native biotic communities (USDI/USDC 1998). The Services are required to develop and implement recovery plans for each threatened or endangered species. Such plans must identify quantified recovery goals (ESA § 4). The number of individuals that constitute a viable population varies not only from species to species, but also from different perspectives on biology. For example, Service biologists have a different view of what a viable grizzly bear population is than do conservation biologists (MacCracken and O’Laughlin 1998).

The amount of risk that a protected species can be subjected to is a subject of debate and intricate negotiation between an agency proposing action and the Services agencies responsible for implementing the ESA. For purposes of implementing the National Fire Plan, three new policies, described below, modify the jeopardy consultation process.

### **ESA – Evaluating the Net Benefit of Hazardous Fuel Treatment Projects**

The directors of the two federal Services agencies responsible for implementing the ESA – the U.S. Fish and Wildlife Service and NOAA Fisheries – have written a guidance document memorandum instructing agency personnel regarding the evaluation of fuel treatment projects and the balancing of short-term risks and long-term benefits:

Some projects may have short-term adverse effects on some endangered and threatened listed species; however, at the same time these projects present opportunities for significant long-term benefits to those species and their habitats. The guidance document encourages the Services to evaluate and balance the long-term benefits of fuel treatment projects, including the benefits of restoring natural fire regimes and native vegetation, as well as the long-term risks of catastrophic wildfire, against any short- or long-term adverse effect (Williams and Hogarth 2002b).

### **ESA – Alternative Approaches for Streamlining Section 7 Consultation on Hazardous Fuels Treatment Projects**

The guidance memorandum immediately above also refers to “streamlining” techniques as a process in which the consulting agencies can jointly develop standards and guidelines for addressing projects that may require balancing of short-term adverse impacts with long-term benefits. The directors of the Services agencies wrote,

Although to date the [ESA] section 7 consultation process has been able to stay ahead of the fire management agencies’ hazardous fuels treatment projects, there is concern that as these agencies accelerate their activities to address public safety concerns, the consultation process could delay hazardous fuels treatment projects. In an attempt to meet the fire management agencies’ needs, the Services have developed this guidance to assist in streamlining the section 7 consultation process for hazardous fuels treatment projects.

In addition, this guidance encourages early coordination and cooperation at the project planning stage, “batching” of similar projects, and use of design criteria or screens to streamline the consultation process while minimizing the potential for adverse effects to listed species and their habitats at both the landscape and site-specific levels.

Implementation of this process within the action agencies’ hazardous fuels treatment programs: (1) lays the foundation for the landscape-level perspective needed to implement programmatic consultation procedures that can greatly accelerate the consultation process; (2) provides the structure for identifying,

evaluating, and balancing the short-term risks and long-term benefits of future activities; and (3) facilitates the development of section 7 consultation “triggers” (i.e., triggers for informal or formal consultation) (Williams and Hogarth 2002a).

### **ESA – Joint Counterpart Endangered Species Act Section 7 Consultation Regulations**

“Joint counterpart” consultation regulations, effective 4 January 2004, allow the establishment of an optional alternative consultation process (USDI/USDC 2003). The regulations eliminate the need to conduct informal consultation for National Fire Plan activities that the action agency determines are not likely to adversely affect listed species or designated critical habitat. The regulations also eliminate the requirement to obtain written concurrence on such determinations from the ESA Services agencies. The rationale for the counterpart regulations follows:

The Healthy Forests Initiative builds from the recognition that more timely environmental reviews of proposed fire plan projects will provide greater benefits to the range, forest lands, and wildlife by reducing the risk of catastrophic wildfire while the reviews are pending. These counterpart regulations provide an additional tool for accomplishing faster reviews.

The Action Agencies’ established biological expertise and active participation in the consultation process provides a solid base of knowledge and understanding of how to implement section 7 of the ESA. By taking advantage of this expertise within the Action Agencies, the counterpart regulations process will help ensure more timely and efficient decisions on planned National Fire Plan actions while retaining the protection for listed species and designated critical habitat required by the ESA and other applicable regulations (USDI/USDC 2003).

### **National Forest Management Act**

The National Forest Management Act (NFMA 1976) requires the USDA Forest Service to develop land and resource management plans with a 10-15 year outlook for each of the approximately 100 planning units in the 191 million acre National Forest System. The statute requires that such plans specify managerial guidelines which “provide for diversity of plant and animal communities based on the suitability and capability of the specific land area . . . and to preserve the diversity of tree species similar to that existing in the region controlled by

the plan” (NFMA 1976). Implementing regulations specifying these guidelines have been problematic, and at this writing, managers have the option of using regulations codified in either 1982 or 2000. In 2004, proposed rules drafted in December 2002 may replace both existing sets of regulations (D. Tenny, personal communication, 11 December 2003).

The NFMA is unusual because Congress specified that a Committee of Scientists was to design the implementing regulations. The first set of regulations was codified in 1982 and require that

Fish and wildlife habitat shall be managed to maintain viable populations of existing native and desired non-native vertebrate species in the planning area. For planning purposes, a viable population shall be regarded as one which has the estimated numbers and distribution of reproductive individuals to insure its continued existence is well distributed in the planning area. In order to insure that viable populations will be maintained, habitat must be provided to support, at least, a minimum number of reproductive individuals and that habitat must be well distributed so that those individuals can interact with others in the planning area (36 CFR § 219.19; revised 1998).

The 1982 “diversity” regulations have launched a flotilla of lawsuits (Padilla 1997, Houck 1997). For National Forest System lands in the Pacific Northwest, the most widely known case, regulations have been interpreted as a “high likelihood” standard (FEMAT 1993). Simultaneous with this situation and partly driven by it, during the 1990s the USDA Forest Service began a transition from sustained yield management to sustainable forest management. Sustained yield emphasizes what is removed from the forest during management activities. Sustainability emphasizes what is left in the forest after management activities. The shift was driven by changing public values and changing interpretation of policies, first by courts and then the agency. One result was an 80 percent decrease in annual timber harvest volumes from federal lands during the 1990s. Another is an increase in timber inventory on these lands that has increased stand density and exacerbated forest health and wildland fire problems (O’Laughlin and Cook 2003).

The other option available to managers is the second set of regulations codified in 2000. These were based on recommendations from a second Committee of Scientists. The 2000 regulations call for a high likelihood of sustaining ecological conditions for native and desirable non-native plant and animal species, including focal species and species-at-risk that serve as surrogate measures of species

diversity. Species-at-risk and focal species must be identified for the plan area, and evaluations of species diversity must include, as appropriate, assessments of the risks to species viability. Such assessments may rely on general conservation principles and expert opinion (USDA-FS 2002b, pp. 72808-72816).

Although the NFMA statute does not specifically address risk, the 2000 regulations do. As indicated above, risk assessments of species viability are required. Furthermore, replacement regulations proposed in December 2002 would require specific consideration of short- and long-term risk trade-offs during the development of plans (USDA-FS 2002b). The risk analysis is illustrated in the proposed regulations with a streamside buffer zone and sedimentation case example:

Another term requiring additional explanation is “risk” as used in the context of scientific risk. If there are known risks associated with plan decisions, then those risks must be described. Risk arises from uncertainty in science, from assumptions made in analysis, from occurrences such as catastrophic events, and from trade-offs made in development of the plan. Trade-offs occur when a Responsible Official decides to accept negative impacts to one resource in order to achieve benefits for another resource.

For example, a plan may have a desired condition for streams that includes components of shading, nutrient loading, reduction of sedimentation, and the recruitment of large organic debris to the stream. Science may show that a 100-foot buffer strip prohibiting harvest of trees is optimum to reduce sedimentation in streams. However, science may also show that the trees in that 100-foot buffer should be of a certain size to optimize shading, nutrient loading, and large organic debris to the stream.

Allowing thinning within buffer strips may be desirable, depending upon specific stand characteristics, to achieve a stand structure that better meets the desired condition for streams. The Responsible Official may trade off the short-term risk of higher sedimentation rates associated with thinning trees for achieving the desired outcomes of shading, nutrient loading, and recruitment of large organic debris in the long term. This risk should be evaluated and disclosed by the Responsible Official.

Substantial risk also occurs when the aggregate sources of risk result in the likelihood that the desired resource or output condition cannot be achieved. For example, in the situation described previously, a large catastrophic fire may cause additional sedimentation, resulting in an inability to achieve the desired condition. This aggregate risk of allowing thinning and potential impacts from catastrophic fire must be evaluated and disclosed (USDA-FS 2002b, p. 72789).

## Risk Assessment Procedures

Risk assessment methods, assumptions, and conclusions differ dramatically across the federal government (Cantor 1996). This leaves open the question regarding what procedures should land management and regulatory agencies follow in assessing the magnitude of adverse environmental effects, the probability that risk events will occur, and comparison of short- and long-term effects of management alternatives. Some agencies have adopted and implemented the *Guidelines for Ecological Risk Assessment* developed by the U.S. Environmental Protection Agency (US-EPA 1998). The USDA Forest Service and the USDI Fish and Wildlife Service recognize and accept the EPA process for ecological risk assessment, but have not fully integrated risk assessment into decision-making processes (CENR 1999). The USDA Forest Service added ecological risk assessment onto the bioregional ecosystem management planning process for the interior Columbia River basin assessment. The planning model also recognized the role of social process in determining acceptable levels of risk (Haynes et al. 1998). However, risk assessment depends on identification of cause and effect relationships between hazards and adverse effects and this was not done in the interior Columbia River basin assessment (Quigley et al. 1998).

Successful risk management depends upon efforts to integrate risk analysis into decision-making processes rather than treat it as an add-on process (Haines 1998). To attain better results, risk management must be placed in its social context (Cantor 1996). If managers know what the public wants, they have a much better chance of providing it because values are why people care about risk management (Keeney 1996). Serious attention to participation and process issues may eventually lead to more satisfying and successful ways to manage risks (Kunreuther and Slovic 1996). As the EPA *Guidelines* put it, the interface among risk assessors, risk managers, and interested parties at the beginning (during planning) and end of the risk assessment process (during risk communications) is crucial for ensuring that the results of the risk assessment can be used to support a management decision (US-EPA 1998). Following further development of risk assessment methods, with emphasis on effective risk communications, attention to social processes for determining acceptability of different risks may be a fruitful approach for federal land managers at the

forest and project planning levels.

Because risk management decisions are complex, a little analysis can provide valuable insights as agencies develop and evaluate management alternatives. If values are explicitly included in the analysis, it is easier to communicate why one alternative is chosen over others. This can result in greater trust in the decision process and the decision makers (Keeney 1996). The willingness to try several approaches to risk management is important. As managers and regulators gain more experience with various approaches for addressing a range of risk management problems, undoubtedly they will discover that some innovations work better than others. This knowledge may help everyone understand how to balance different values in all areas of risk management (Cantor 1996).

Although standardization of policies and procedures among federal agencies is an ongoing objective in wildland fire management (NIFC 2001), different agencies can be expected to have different perceptions of risk. Based on their values, different stakeholders and interest groups also will perceive risks differently. Unless there are appropriate forums for reconciling such differences, information developed in risk assessments is unlikely to change the way land and resource management decisions are made. The power differential the ESA gives the regulatory Services agencies allows them to force changes in action agency projects through the consultation process. Although the ESA Services agencies have new guidance from the directors' offices to adopt new approaches to balancing risks, whether such guidance will affect how agents go about their business in the field is problematic.

Wildland fire risk managers may want to take the initiative for developing new risk assessment approaches. One suggestion is to continue trying to adapt the EPA *Guidelines* to meet their needs, as the USDA Forest Service has attempted (see Haynes et al. 1998, Cleaves and Haynes 1999, Sommers et al. 1999). The *Guidelines* have some serious shortcomings, including the lack of methods for

comparing different risks. Another suggestion is to develop alternative approaches to the entire risk analysis process. Consistent with the *Guidelines*, I suggest beginning with a simple conceptual model for comparative ecological risk assessment. The model should be capable of comparing project risks and benefits that arise from different sources in the short and long term. Special attention to communications and social processes will be necessary for action agencies and regulatory agencies to sort out their different cultures and values, and for agencies to work with their diverse publics. I have attempted to develop such a model (O'Laughlin 2003, 2004 a,b). It is designed to meet the needs for effective risk communications that are driven by existing laws and policies requiring risk analysis in federal land and resource management decision-making processes.

## Conclusion

This review of laws and policies supports the conclusion that federal land and resource management agencies, and regulatory agencies responsible for endangered species conservation, must use some form of risk assessment in their decision-making processes. Risk analysis, however, should not be viewed as a panacea for federal land management. Rather, it is a transparent method for systematically developing and displaying for communication purposes the information base upon which decisions involving risk and uncertainty are made.

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