

Environmental Law for Biologists

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CHAPTER ONE

Introduction to Environmental Law

The Chequamegon-Nicolet National Forest covers more than 600,000 hectares (1.5 million acres) in northern Wisconsin. As a national forest, Chequamegon-Nicolet is owned and managed by the federal government. Managing such a large area is by no means easy, considering that the forest contains hundreds of lakes and streams, thousands of miles of roads and trails, and considerable recreational and logging activity. Before being combined in 1998, the Chequamegon and Nicolet forests were officially two separate national forests, both managed by the US Forest Service. As part of its management duties, the Forest Service in 1979 began developing management plans for the separate Nicolet and Chequamegon National Forests. By 1986 the Forest Service had issued final drafts for both management plans.

In writing management plans, the Forest Service cannot simply do whatever it pleases. The federal statute that determines how the Forest Service must manage national forests is the National Forest Management Act (NFMA). Among other things, the NFMA requires Forest Service management plans to “provide for diversity of plant and animal communities.”¹ As a consequence, the Forest Service is legally required to protect biodiversity on the lands the agency manages. The NFMA, however, does not give any specifics on how the Forest Service is meant to protect biodiversity, leaving that up to the agency to decide. (The NFMA is discussed in greater detail in chapter 5.)

To protect biodiversity in Nicolet and Chequamegon, the Forest Service made an important assumption: biodiversity could be protected by maintaining the diversity of habitats in the forests. In other words, the Forest Service

assumed that habitat diversity could act as a proxy for species diversity. To maintain habitat diversity, the Forest Service management plans identified several representative animal species from the two forests, and then calculated the habitat types and patch sizes necessary to maintain minimum viable populations of those species. The plans then divided the two forests into patches of those habitat types, with the patches being just large enough for the maintenance of the representative species. These relatively small patches were interspersed with other areas slated for logging or road building.

In 1990 the Sierra Club sued the Forest Service over the contents of the Nicolet and Chequamegon management plans.² The Sierra Club argued that the Forest Service had not used scientific knowledge gained from conservation biology in creating its management plans. Conservation biology research clearly shows that viable populations are best maintained in large patches, ideally extending over an entire landscape. The management plans by the Forest Service instead fragmented the forests “into a patchwork of different habitats.”³ These small patches were bound to suffer from edge effects, limited migration, small population sizes, and other problems that would make the survival of species on those patches difficult. The Sierra Club maintained that the Forest Service had completely ignored ecological research on population dynamics, fragmentation, edge effects, and island biogeography in writing its management plans. The Sierra Club also claimed that by not using the findings of conservation biology, the Forest Service was not fulfilling the requirement of the NFMA to protect biodiversity.

The Forest Service countered that the hypothesis that fragmentation of a forest from timber harvesting and road building may be detrimental to plant and animal diversity had “not been applied to forest management in the Lake States.”⁴ The Forest Service added that the theories of conservation biology and island biogeography were of interest, but that “there is not sufficient justification at this time to make research of the theory a Forest Service priority.”⁵

A federal appellate court, in *Sierra Club v. Marita*, agreed with the Sierra Club that the principles of conservation biology are sound. Nevertheless, the court held that the Forest Service management plans for Nicolet and Chequamegon had met the requirement of the NFMA to protect biodiversity. How could the court come to both of these conclusions? As discussed later in this chapter, courts are required to give considerable deference to the decisions made by a federal agency. The court in *Marita* deferred to the Forest Service in its determination that conservation biology principles were uncertain in their application to Lake States forests in the 1980s. The court

further wrote that the Forest Service is “entitled to use its own methodology, unless it is irrational.”⁶ Consequently, the Forest Service was free to use the management plans it had written, ignoring some of the most widely accepted principles of conservation biology in managing the Nicolet and Chequamegon National Forests.

The *Marita* case illustrates that in environmental law, scientific rigor is not always considered to be the highest value. Here the court believed that the value of the judicial branch’s respecting the decisions of the executive branch outweighed the value of adhering to conservation biology principles. As the rest of the chapter explores, this outcome is far from an anomaly.

Environmental law may be broadly defined as the statutes, regulations, and court decisions that manage the effects of human activity on the natural environment. Managing how humans impact the environment is a hugely difficult undertaking, and the length and complexity of many environmental laws is a testament to that difficulty. To manage anything effectively, you of course have to understand what you are managing. The best way to understand the natural environment is through scientific inquiry. The three branches of the federal government certainly understand this, and they rely on scientists and scientific data when writing and implementing environmental laws. As the *Marita* case illustrates, however, the three branches also frequently consider factors other than science when writing and implementing those laws. An understanding of environmental law is incomplete without an understanding of how the three branches of government attempt to balance these other factors along with science when managing how humans impact the natural environment.

As will be seen throughout the book, this balancing often results in conflict between science and law. Ecological principles may point to a certain action to protect species or ecosystems, but the law may allow or even require a completely different action. At a more fundamental level, the law frequently calls on science to make value judgments, even though scientific inquiry is ideally objective and without a value system. Science alone cannot decide how much money should be spent to save a species from extinction, or place a dollar value on a single human life. Finally, science is usually an integrative discipline, interested in understanding the interconnectedness of different systems. Statutes, on the other hand, tend to regulate one discrete area at a time. For instance, a specific statute may regulate only marine mammals, or only migratory birds. Because of this focus on one discrete area, statutes are often oblivious to how regulating that one area will influence other areas outside the focus of the statute. The result is that the law treats

nature as discrete units that can be manipulated and swapped for each other without impact to other units of nature. As a consequence, the ways in which science and the law attempt to understand and categorize the world are at odds with each other. Each of these conflicts is discussed in this chapter, and they present themselves throughout the rest of the book.

The chapter first explains that Congress often writes environmental statutes to require federal agencies to use science in their decision making, but the statutes rarely indicate how science is specifically meant to be used. This vagueness gives federal agencies flexibility in applying the law, but also allows Congress to hide behind ambiguity when hard decisions need to be made. Next the chapter discusses that although federal agencies are the most adept branch of the government in using science, they are frequently tempted to use the trappings of science to further agency goals. Finally, the chapter discusses how courts defer to the scientific expertise of federal agencies; in other types of cases not involving agencies, however, judges with no scientific training are left to rule on the validity of scientific findings.

C O N G R E S S

When Congress writes statutes, it quite often includes requirements that federal agencies rely, at least in part, on science in making decisions. Several environmental statutes specifically state that agencies must make certain decisions based on the “best available scientific information.”⁷ Other environmental statutes do not use such specific language, but imply that only scientific information should be considered when making certain decisions (see box 1.1 for a discussion of the types of problems environmental statutes often address).⁸

Congress includes requirements for the use of science because science is generally viewed as being objective and nonpartisan. Including a requirement for scientifically based decision making helps make a statute appear legitimate to the public. Congress may also mistrust the politically appointed officials running federal agencies, and statutorily requiring that decisions be scientifically based may be a way to limit the discretion of those officials.⁹

Less charitably, a requirement for decisions based on science may be a way for lawmakers to create cover for themselves to avoid having to take responsibility for unpopular decisions made under the statute.¹⁰ This is problematic because it perpetuates an unrealistic view of what science can accomplish.¹¹ As mentioned in the introduction to this chapter, science by itself cannot place a value on environmental resources, or determine how

BOX 1.1. EXTERNALITIES AND COMMAND AND CONTROL

Many of the environmental laws Congress passes are attempts to deal with externalities. An externality is a cost that must be borne by those who did not choose to incur that cost. For example, in the absence of environmental laws, a factory that releases pollutants into the air would not have to pay anything to release those pollutants, because the atmosphere is a public good and does not belong to anybody. The public, on the other hand, would have to bear the cost of that pollution in the form of health problems and environmental degradation. This is called a negative externality.

There are also positive externalities. A positive externality imposes a positive effect on those who did not choose to receive that effect. For example, a farmer may have a wetland on her property that helps prevent pollution from reaching a river that is used as a source of drinking water by a downstream city. The people of the city benefit from the wetland's providing them with clean water to drink, but the farmer is not paid for that benefit. As a result, the farmer has no incentive to keep the wetland, and may decide to fill it in for additional cropland.

Environmental laws often try to internalize externalities. For instance, a law may impose a tax on facilities that emit pollutants to internalize negative externalities, or a law may pay landowners not to destroy valuable land to internalize positive externalities.

The most common way environmental laws internalize negative externalities is through command-and-control regulations. These regulations are laws that mandate what an individual or business may or may not do. A law that requires a factory to install a specific type of scrubber on a smokestack to reduce its emission of air pollutants would be a command-and-control regulation. More recently, governments have begun creating environmental laws that reduce negative externalities through the use of market-based approaches. Market-based approaches utilize economic markets to provide incentives to reduce negative externalities. The most common type of market approach gives permits to polluters for the right to emit pollutants, and then allows polluters to trade those permits on an open market. The acid rain program (see chapter 10) is the most famous example of a market-based approach to internalizing negative externalities. Command-and-control regulations and market-based approaches are seen throughout the book.

to balance the protection of those resources against other needs, such as for development or private property rights. By requiring decisions to be scientifically based, environmental statutes imply that science can do that balancing, and that such decisions can be completely objective and not value judgments. As an example, the Endangered Species Act states that when deciding whether to list a species as threatened or endangered, the Fish and Wildlife Service must make that decision “solely on the basis of the best scientific” information (see chapter 3).¹² While science can provide information on the probability of a species going extinct within a certain number of years, science alone cannot decide at what probability public resources should be spent to reduce the likelihood of extinction.¹³ The probability of extinction that society is willing to accept is not a strictly scientific determination. Congress, however, sidesteps deciding the acceptable probability when it requires that listing be based solely on science. Instead, Congress forces the Fish and Wildlife Service to make the decision. Requirements for the use of science in environmental statutes may frequently be a way for Congress to tell federal agencies to make the value judgments that are fundamental to the statute because it is too difficult for Congress to do.

An additional problem with environmental statutes requiring federal agencies to use science is that the statutes rarely indicate how the agencies are supposed to use science, or suggest what kinds of science to use. There are several reasons for this vagueness. In order for a bill to pass Congress, the language often must be ambiguous enough to garner a majority of votes. Any language in a bill that is too specific on how science should be used may lead to a loss of votes. Additionally, lawmakers understand that scientific knowledge is constantly changing, and any specific requirements may quickly become outdated. Finally, lawmakers realize that they are not scientific experts, and they may very well make mistakes if they try to put specific scientific requirements into statutes.

The lack of scientific knowledge in Congress is best illustrated by looking at how bills are drafted. Almost no member of Congress actually drafts bills. Some bills are drafted by lobbyists or federal agencies and then presented to members of Congress. Most commonly, members of Congress rely on the Offices of Legislative Counsel to draft bills. Both the Senate and House of Representatives have nonpartisan Offices of Legislative Counsel that focus entirely on writing legislation at the direction of lawmakers. In this arrangement, members of Congress and their staffs focus on policy, and then work with the Offices of Legislative Counsel in translating that policy into a written bill.¹⁴ Although members of Congress and their staffs oversee the drafting process, it is ultimately the lawyers in the Offices of Legislative Counsel

that choose most of the words in a bill, and that choice of words may have great importance in how a law is interpreted and implemented. Courts frequently base their interpretation of a provision in a statute on a single word or phrase in that provision (see box 1.2 for a description of how legal materials are cited and how to perform legal research).

BOX 1.2. LEGAL CITATIONS AND RESEARCH

One of the first things to understand before performing legal research is how laws and other legal materials are cited. Federal statutes are officially compiled in the *United States Code* (U.S.C.). The *United States Code* is composed of several titles, and each title has multiple sections (§). For instance, 16 U.S.C. § 703 refers to title 16, section 703 of the *United States Code*. Section 703 happens to be the first section of the Migratory Bird Treaty Act. Most statutes appear in the code in consecutive sections, although there are exceptions. The citation 16 U.S.C. §§ 703–712 refers to all the sections of the Migratory Bird Treaty Act. To get a good grasp on an environmental statute, there is no substitute for sitting down and simply reading all the sections of the statute. The fastest way to access the *United States Code* is through the Legal Information Institute website, operated by Cornell University (www.law.cornell.edu).

Federal agencies in the executive branch write federal regulations. Federal regulations fill in the details of statutes, and can therefore be very long and complex. Federal regulations are compiled in the *Code of Federal Regulations* (C.F.R.). The *Code of Federal Regulations* is also composed of multiple titles and sections, so 50 C.F.R. § 17.1 refers to title 50, section 17.1 of the *Code of Federal Regulations*. The sections of a regulation implementing a particular statute are usually listed consecutively in the *Code of Federal Regulations*. Federal regulations are most easily accessed through the US Government Printing Office website (www.ecfr.gov).

Federal agencies provide announcements and explanations for the regulations they write in the *Federal Register* (Fed. Reg.). *Federal Register* documents are not legally binding, but are important for understanding the reasoning and interpretation of federal regulations. The *Federal Register* can be searched through www.federalregister.gov. Almost all the federal agencies have frequently updated websites that contain numerous documents that help explain environmental laws and regulations.

Opinions written by courts are assembled in case reporters. The decisions are placed in the reporters in chronological order, not based on topic. Federal district court decisions are published in the *Federal Supplement* (F. Supp.), which has been continued into a second series (F. Supp. 2d). A district court decision is cited as *Natural Resources Defense Council v. Kemptborne*, 506 F. Supp. 2d 322

(E.D. Cal. 2007), indicating that the decision can be found in volume 506, page 322, of the second *Federal Supplement* series. The citation also includes the court issuing the decision and the year of the decision, in this case the Eastern District of California in 2007. If a second number follows the page number in the citation, that is a pincite, indicating that the citation is meant to point to that particular page of the decision.

Federal appellate court decisions are reported in the *Federal Reporter* (F.), which is currently in the third series. The federal appellate case *Sierra Club v. United States Fish and Wildlife Service*, 245 F.3d 434 (5th Cir. 2001) refers to a decision published in volume 245, page 434, of the third series *Federal Reporter* by the Fifth Circuit Court of Appeals in 2001.

Supreme Court decisions are reported in the *United States Reports* (U.S.), with a citation such as *Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*, 515 U.S. 687 (1995). As there is only one Supreme Court, there is no need to specify the court in the citation.

Last, law review papers are an excellent way to understand the broader legal and policy implications of environmental laws. Every law school has at least one, and usually several, law review journals that it publishes multiple times a year. Law review papers written by professors or practicing attorneys are usually referred to as articles, while papers written by law students are termed notes or comments.

When doing legal research, the best way to search for information is through the databases Westlaw and LexisNexis. Both Westlaw and LexisNexis archive all manner of legal materials, from statutes to law review articles. The opinions written by the various courts can be difficult to find without using one of these databases. Unfortunately, neither Westlaw nor LexisNexis is free to access. The Web of Knowledge database indexes several law review journals, but again, the database is not free to access. A free but less complete database of legal materials is available at www.justia.com.

The staff of the Offices of Legislative Counsel are lawyers, and do not necessarily have any training in science or the subject of the bill they are drafting. There are only 83 staff members in the two offices, meaning that each must work on drafting bills covering a wide array of subjects.¹⁵ As a result, the scientific language in most statutes is likely to have been written by someone who does not have any training in science, or any special knowledge of the subject of the bill. Furthermore, researchers conducting a survey of congressional staff found that members of Congress and their staffs do not bother to read most of the bills the offices draft, and even when they do, they have difficulty understanding the statutory language in the bills

and how well it reflects the policy intentions of the members of Congress.¹⁶ Consequently, the scientific language in a bill may not be particularly well understood by the people drafting the bill or the people voting on the bill.

FEDERAL AGENCIES

The task of deciding how to use science in implementing environmental statutes falls most squarely on the federal agencies. Many agencies have trained scientists who conduct research and regularly publish in peer-reviewed journals. They also frequently rely on research by, and consultations with, academic scientists.

Being the branch of government with the greatest scientific expertise, the federal agencies can take advantage of the other branches of government. Federal agencies occasionally use, or ignore, scientific research as a means to justify decisions that they have already made. The *Marita* case at the beginning of this chapter shows that the Forest Service was willing to ignore conservation biology research because it conflicted with how the agency wanted to manage two national forests.

A different example also comes from the Forest Service. By the early twentieth century, the Forest Service had begun to realize that grazing livestock on rangeland managed by the Forest Service was having a detrimental impact on rangeland ecosystems.¹⁷ In response, the Forest Service decided to develop measures to estimate the maximum amount of livestock that could graze a given rangeland without degrading it. This maximum grazing level was termed a carrying capacity, and was considered fixed for a particular rangeland. By setting a fixed carrying capacity, the Forest Service could reduce livestock grazing on a rangeland, and could point to the carrying capacity when pressured by ranchers to increase grazing. Forest Service scientists quickly realized, however, that rangeland conditions vary over time and after disturbances, and that a carrying capacity for grazing that is fixed at one level every year makes little ecological sense. Nonetheless, the Forest Service maintained the fixed carrying-capacity concept for many years because of its usefulness in justifying the decision to reduce grazing pressure on Forest Service rangelands.¹⁸

Regulations

If Congress passes a statute that makes vague pronouncements on the usage of science, the details are usually filled in by regulations promulgated by a federal agency. Box 1.3 explains the process of promulgating regulations, as

well as the difference between regulations and guidance documents. By filling in the details left out of statutes, regulations are often where the balancing of social values takes place. The way in which proposed regulations are approved by the White House, however, tends to put a greater emphasis on economic considerations than on other values.¹⁹

BOX 1.3. AGENCIES, REGULATIONS, AND GUIDANCE DOCUMENTS

Most federal agencies are created by Congress through statutes. One prominent exception is the Environmental Protection Agency, which was created through an order signed by President Nixon. Once a federal agency has sprung into existence, its authority to act comes from Congress. Congress tells the agencies what to do through legislation, and then appropriates funds for the agencies to operate.

Although Congress sets an agency's duties, agencies have a great deal of discretion in how they go about undertaking those duties. Most employees in federal agencies are career employees, but the top officials are appointed by the president. These political appointees set the priorities of the agencies.

When Congress passes a statute that an agency must implement, the details of how to implement the statute are often sketchy at best. There are several reasons for this: to get a bill through Congress that will receive a majority of votes, the bill must be vague on details; members of Congress are not experts in the fields in which they pass legislation, so they leave how to implement statutes to the agencies that do have that expertise; and Congress could not possibly anticipate all the details that are necessary in implementing a statute, so they leave those details to be worked out by the agencies. The way federal agencies fill in the details of statutes is through promulgating regulations and writing guidance documents.

Regulations are rules written by federal agencies. A proposed regulation must go through a notice-and-comment process, meaning that an agency publishes the proposed regulation in the *Federal Register* and then interested parties have an opportunity to send comments to the agency. After considering the comments, the agency may issue a final regulation. Once final, the regulation has the force of law.

Promulgating a regulation is a formal process, and takes considerable time. Agencies often issue guidance documents to more quickly set down rules for implementing statutes. There is no requirement for a notice-and-comment process to issue a guidance document. As a result, guidance documents do not have the force of law. Because of this, agencies may not always strictly follow their own guidance documents, and citizens are not compelled to do so.

It may seem odd that unelected officials in the executive branch can write regulations that have the force of law. There are limits to this power, however. Federal agencies may not go beyond the authority they are given by a statute in promulgating a regulation. For example, FWS could not promulgate a regulation to stop the spread of an invasive species just because the agency thought it would be useful. The regulation would have to fit within the authority given to FWS from a specific statute or set of statutes.

Additionally, if a person believes a federal agency has incorrectly interpreted a statute in its regulations and has standing to do so, the person may sue the agency. In deciding whether a federal agency has correctly interpreted a statute in promulgating a regulation, courts follow the test created by the Supreme Court in *Chevron U.S.A. v. Natural Resources Defense Council*.*

*467 U.S. 837 (1984).

Under Executive Order 12,866, when a federal agency is drafting a new regulation, the agency is required to “assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating.” Agencies are then directed to choose regulatory approaches that “maximize net benefits” unless a statute specifically requires a different regulatory approach. The executive order also requires the Office of Information and Regulatory Affairs (OIRA) within the White House Office of Management and Budget to review significant proposed regulations from almost all federal agencies. As part of the review, OIRA also looks at the cost-benefit analyses that agencies perform on their proposed regulations. During the review process, OIRA may require an agency to change its proposed regulation, or to withdraw the regulation completely. OIRA is staffed primarily by economists, and therefore tends to view regulations through an economic lens.²⁰ A report by the US Government Accountability Office found that OIRA reviews of proposed regulations are primarily concerned with reducing the costs or improving the cost-effectiveness of regulations.²¹ The report also found that the emphasis on cost did not necessarily result in an increased net benefit to society. Some scholars have concluded that the OIRA review is less of an exercise in overseeing cost-benefit analyses and more of an opportunity for the White House to insert political considerations into agency regulations.²²

The OIRA review of proposed regulations is particularly intense on regulations touching the environment. Between 1998 and 2000, OIRA changed almost 90% of Environmental Protection Agency (EPA) proposed regulations.²³ For instance, in 2001 the EPA proposed a regulation under the Clean

Water Act that would have required power plants that withdrew at least 189 million liters (50 million gallons) of cooling water every day from estuaries or tidal rivers to meet a new uniform national standard for intake structures as a way to reduce deaths to aquatic organisms.²⁴ The proposed regulation would have cost \$610 million per year, with benefits of \$890 million per year, resulting in a net benefit to humans and the environment of \$280 million per year. The OIRA then undertook its review of the regulation. Instead of new uniform standards for intake structures, OIRA suggested site-specific standards for intake structures. More importantly, OIRA suggested allowing power plants to restore waterways as a means of substituting for the installation of improved intake structures. The regulation as revised by OIRA would cost \$280 million per year, have benefits of \$735 million, resulting in a net benefit of \$455 million. With the intervention of OIRA, the net benefit of the revised regulation was larger, but the absolute benefit to humans and the environment was \$155 million smaller. The revised regulation was published in 2002. In balancing the protection of environmental resources with economic costs, OIRA helps keep the scales tipped toward economic considerations, even if the absolute benefit to the environment is considerably smaller.

Adaptive Management

Once a federal agency has promulgated a set of regulations, the agency must then implement those regulations. For environmental statutes and regulations, that means undertaking the management of environmental resources. Ecological systems are complex, and even with considerable information about a particular ecosystem, how it will respond to an agency's management actions may be difficult to predict. One can think of ways of dealing with this uncertainty as being on a spectrum.²⁵ On one end is the precautionary principle; in this context, the precautionary principle requires that any management action that could harm the environment, such as allowing oil or gas exploration, requires scientific evidence that the activity will not cause harm before the agency allows the action to proceed. On the other end is the "sound science" approach. The "sound science" approach is the opposite of the precautionary principle, in that it requires scientific evidence that an action will harm the environment before the action is prohibited. Finally, in the middle is adaptive management, and it comes in several guises.

Active adaptive management means implementing a variety of management practices in multiple patches of the management area at the same

time.²⁶ Differences in the results of these various management practices are observed, and then used to create a new set of management practices to implement and observe. This is essentially performing replicated experiments on the outcomes of management practices, learning from those outcomes, and then performing new experiments. While replicated patches are the ideal, active adaptive management can also be done on a single patch as long as an experimental approach is taken to making management decisions. Passive adaptive management on the other hand means creating mathematical or computer models of the ecosystems in a management area. Managers use the models to suggest management actions for the entire management area, then collect data on the outcomes of that management. That data is then fed back into the model, suggesting new management actions. Finally, haphazard adaptive management means undertaking management actions randomly, or based on instinct, and then collecting data on the outcome of that action. This is more akin to trial and error than true adaptive management.

Many federal agencies claim to use active or passive adaptive management in managing environmental resources. Three problems tend to arise, however, when federal agencies actually try to implement adaptive management.²⁷ First, the individuals responsible for making management decisions in federal agencies are often risk averse, and do not want to approve management experiments that may be considered failures. For instance, the Northwest Forest Plan was adopted in 1994 as the guidelines for managing federal lands in the Pacific Northwest. The plan specifically created 10 adaptive management areas (AMAs) covering 607,000 hectares (1.5 million acres) to experiment with different management actions. The Forest Service and Bureau of Land Management (BLM) jointly oversaw the AMAs. Subsequent interviews with employees at the Forest Service and BLM found, though, that there was very little effort to engage in adaptive management in the AMAs.²⁸ Employees indicated that experimentation and risk taking were not rewarded by supervisors in these agencies, making the experimentation required by adaptive management professionally unrewarding. To be fair, part of this aversion to risk arose because of the fear of litigation if any experimental management action harmed a threatened or endangered species.

Second, federal agencies may use the process of adaptive management to justify management actions the agency has already decided to pursue. For example, if an agency wants to allow oil or gas drilling on the lands it manages, allowing that drilling in certain areas could be justified as experimentation under active adaptive management. If an agency instead employs passive adaptive management, the agency may be able to subtly alter man-

agement models to make the management action that the agency prefers appear to be the best option.

Third, there is a systemic lack of environmental monitoring by federal agencies. Adaptive management is pointless if there is no attempt to observe and learn from the outcomes of different management actions. The lack of environmental monitoring by federal agencies deserves its own section and will be discussed in greater detail next.

While adaptive management continues to be recommended by many scientists and legal scholars, less flexible management methods may occasionally do more to protect environmental resources.²⁹ A plan that sets out well-defined management actions may be more difficult for an agency to use as cover to implement preferred actions. Additionally, less flexible management plans may be easier for the public to understand and criticize (and possibly litigate). Adaptive management will likely remain the best management option when there is a clear management goal, and when it is respected by an agency's hierarchy as a tool to reach that goal.³⁰ If the management goal is unclear and the agency hierarchy is very risk averse, however, a less flexible management plan that forces the agency to clearly indicate its management actions may be more beneficial to the environment.

Environmental Monitoring

A federal agency will have difficulty determining the effects of its management actions if there is inadequate monitoring of the area being managed. An agency may monitor the wrong things, or may simply not do any environmental monitoring in the first place.

There has been considerable scientific research on the best ways to monitor ecosystems, but federal agencies have historically been slow to adopt the lessons of this research. The finest example of this is the use of management indicator species (MISs) by the Forest Service (see chapter 5). An MIS is a species that the Forest Service believed could act as a proxy for all the other vertebrate species in a given area. By monitoring the condition of the MIS, the Forest Service thought it would know the condition of all the other vertebrate species in the ecosystem. The Forest Service regulations of 1982 required management plans to include MISs as indicators of the functioning of forest ecosystems. However, the idea that a handful of indicator species could act as proxies for the functioning of an entire ecosystem was widely rejected by ecologists soon after the 1982 regulations were promulgated.³¹ It was not for another 30 years, however, that new Forest Service regulations

eliminated the requirement for MISs, instead requiring the use of focal species as a way to monitor ecosystem functioning.

Since at least the early 1980s, ecological research has pointed to the use of more holistic ecosystem-based monitoring.³² By the late 1990s, the EPA decided to reevaluate how it conducted environmental monitoring, and asked the National Research Council (NRC) to evaluate biological indicators.³³ The NRC noted that indicators monitored by federal agencies are of great significance because they will be used in setting public policy. As a consequence, these indicators must be “understandable, quantifiable, and broadly applicable.” The NRC argued that indicators are more influential if there are fewer of them, and if the indicators are easily understood by the public. The NRC also reasoned that the rules for calculating an indicator should be objective and clear, so that the public has confidence that the indicators are not easily influenced by outside interests. The NRC recommended indicators in three categories: (1) indicators for the extent and status of ecosystems should be land cover and land use; (2) indicators for ecological structure should be total species diversity, native species diversity, nutrient runoff, and soil organic matter; and (3) indicators for ecological function should be carbon storage, production capacity, net primary productivity, lake trophic status, stream oxygen, nutrient-use efficiency, and nutrient balance. Despite the NRC report, the use of all these indicators by a federal agency in its management areas is extremely rare.

While monitoring the wrong things is problematic, not doing any monitoring is even more so. There are several reasons an agency may decide to make environmental monitoring a very low priority. Long-term ecological monitoring is expensive, and federal agencies would rather spend that money on other activities. For instance, a Government Accountability Office report from 2005 found that BLM had moved funds for wildlife monitoring toward permitting for oil and gas development. Additionally, outside interests may push for less monitoring, so that there is less of a scientific basis for new regulations. Federal agencies may also prefer to collect only the minimum amount of monitoring data necessary to justify maintaining the current management plan—additional data may be used against the agency by politicians or the courts. For that reason, agencies often prefer to use models to justify management actions because the assumptions in a model are easier to subtly alter to produce the preferred results than are empirical monitoring data. Finally, scientists in federal agencies view ecological monitoring as rather boring and unlikely to lead to advancement within an agency.³⁴

One legal scholar suggests the creation of an independent federal agency that is solely concerned with conducting environmental monitoring and overseeing the monitoring done by other agencies. He argues that an independent agency would likely be perceived by the public and lawmakers as unbiased and less influenced by outside interests. The US Geological Survey is a federal agency that already has as its primary mission conducting research on environmental issues. The scholar suggests that the US Geological Survey would be well positioned as an independent agency that conducts widespread environmental monitoring, while also overseeing monitoring by other federal agencies.³⁵

Regardless of whether an independent agency is created, the current lack of high-quality environmental monitoring makes adaptive management of federal lands difficult at best. It also lets agencies claim their management practices are protecting environmental resources, because the agency is not collecting evidence that would suggest the contrary. This may become especially important if an agency's decisions are reviewed by a court.

COURTS

The last branch of the federal government that must consider the place of science in the law is the courts. Unlike federal agencies that employ hundreds of scientists, judges and the lawyers arguing in front of them do not necessarily have any scientific training. For that reason, the courts have several rules that they use to make sure the science they consider is legitimate and applies to the case at hand.

Expert Witnesses

Before considering how courts judge the use of science by federal agencies, it is worth noting how courts deal with science in other types of cases. There are of course many types of cases where scientific evidence may be important. For example, a jury might rely on the testimony of a scientist that the pollutants released into a river by an industrial facility were the direct cause of a massive fish kill. Scientists testifying in a court case are called expert witnesses. Although courts recognize that expert witnesses are important in helping a jury understand the facts of a case, courts are also wary of the power of expert witnesses to sway juries and judges. Occasionally an expert witness is not actually an expert, or is testifying about scientific ideas that are not considered reliable by the scientific community. A jury or judge, how-

ever, may not have the scientific knowledge to know that the expert witness is unreliable. This threat is ideally overcome by the *Daubert* standard and the Federal Rules of Evidence.

In the past, judges would decide whether to allow expert testimony by looking at whether an expert was testifying on a method or theory that had gained general acceptance in the relevant scientific field.³⁶ Judges played a limited role, allowing in science as long it was generally accepted by scientists as valid. The Supreme Court overturned that way of deciding on expert testimony in *Daubert v. Merrell Dow Pharmaceuticals, Inc.* The court in that case wrote that trial judges must act as gatekeepers to prevent the testimony of unreliable expert witnesses.³⁷

In performing the gatekeeping function required by *Daubert*, a trial judge must ensure that an expert's testimony is based on reasoning or methodology that is scientifically valid, and can properly be applied to the facts at issue. The Supreme Court listed five factors that a judge can consider: (1) whether a theory or technique used by the expert can be and has been tested; (2) whether the theory or technique has been subjected to peer review and publication (lack of publication does not automatically eliminate an expert's testimony, but it is relevant for a judge to consider); (3) the known or potential rate of error of a scientific technique; (4) the existence and maintenance of standards controlling a technique; and (5) general acceptance of a theory or technique in the scientific community. These factors are nonexclusive, and courts may consider other factors in deciding whether to allow expert testimony. In a subsequent case, *Kumho Tire Co. v. Carmichael*, the Supreme Court wrote that this gatekeeping function also applies to technical experts, not just scientific experts.³⁸

The *Daubert* standard is now affirmed in rule 702 of the Federal Rules of Evidence. For federal courts, the Federal Rules of Evidence govern what evidence may be presented at a trial. Rule 702 states that a person is qualified as an expert by "knowledge, skill, experience, training, or education." Such an expert may testify in a case in the form of an opinion if (1) the expert's scientific knowledge will help the judge or jury understand the evidence or facts in a case; (2) testimony is based on "sufficient facts or data"; (3) the testimony is the product of "reliable principles and methods"; and (4) the expert has "reliably applied" those principles and methods to the facts in the case.

There are critics of the *Daubert* standard, chief among them being former Chief Justice Rehnquist. In his dissent to the *Daubert* decision, Justice Rehnquist wrote that the *Daubert* standard turns trial judges into "amateur

scientists” who must determine the scientific validity of an expert’s testimony even though most judges do not have a background in science. Other scholars have argued that the lack of a requirement in *Daubert* that theories or techniques be peer-reviewed or have gained general acceptance may result in junk science being presented in court. An empirical study from 2001 found, though, that judges were actually applying stricter standards to expert evidence under the *Daubert* standard, and were more likely to prevent an expert from testifying, than before the advent of the standard.³⁹ The study also found that even general acceptance of a theory or technique in a scientific field was occasionally insufficient for a judge to consider it reliable. As a consequence, the *Daubert* standard may not only help keep out junk science, but may also tend to prevent new theories and techniques from making it into courtrooms.

Chevron Deference

As discussed in a previous section, one of the most important ways federal agencies use science is incorporating it into regulations. When examining regulations, courts do not follow the *Daubert* standard; they are instead much more deferential. When a federal agency makes a rule, such as a regulation, courts usually defer to the agency’s rule making. Courts consider this reasonable because federal agencies have much greater expertise in implementing statutes than do judges.

To determine when a court must defer to a rule made by a federal agency, the Supreme Court established a two-step test in *Chevron U.S.A. v. Natural Resources Defense Council*.⁴⁰ In the first step of the test, a court determines whether the statute directly addresses the question at issue. If so, then the statute trumps the rule, and the court stops its analysis there. If the statute does not directly address the question, the court moves to the second step. In the second step, the court determines whether the agency’s interpretation of the statute in the rule is a “permissible construction of the statute.” The agency’s interpretation need not be the best interpretation, or even a particularly good one. As long as the interpretation is reasonable, then the agency’s rule will stand. As a consequence, the Supreme Court has held that courts must give considerable deference to the rules agencies create.

The Supreme Court curbed the requirement for deference a bit in a subsequent case, *United States v. Mead Corp.*⁴¹ In *Mead*, the court held that another step must come before the two-step *Chevron* test. A court must first ask if Congress delegated authority to a federal agency to make a rule carrying the force of law, and if the rule promulgated by the agency was in the exer-

cise of that authority. If this first step is passed, then the court may move to the two-step *Chevron* test. If, however, an agency created a rule that is not based on a delegation of authority from Congress, then *Chevron* does not apply. Instead, a court must decide whether the agency's rule stands based on several factors. These factors are the thoroughness evident in the agency's consideration; the validity of its reasoning; its consistency with earlier and later decisions; and "all those factors which give it power to persuade, if lacking power to control."

In the facts of the *Mead* case, the US Customs Service classified day planners as diaries, making them subject to a 4% tariff. This tariff classification required no notice-and-comment period, such as for a regulation, and the Supreme Court found that the classification was not intended by Congress to carry the force of law. As a result, the tariff classification did not receive *Chevron* deference. The Supreme Court did write, though, that such decisions by federal agencies must receive respect from courts according to their persuasiveness.

The results of *Chevron* and *Mead* together describe the level of deference courts must give federal agencies. The regulations promulgated by agencies, and the science in those regulations, receive *Chevron* deference. Many specifics of how science is used by an agency, though, appear in the manuals or guidelines written by that agency. As these manuals and guidelines are not rules created under authority delegated by Congress, they do not receive *Chevron* deference; they instead fall under the *Mead* standard. Courts, however, still give deference to such documents based on their persuasiveness. Empirical studies find that when applying *Chevron*, courts affirm agency decisions 73% of the time.⁴² When applying *Mead*, courts affirm agency decisions 60% of the time.

Chevron and *Mead* deference apply when an agency is interpreting an ambiguous statute. When an agency is making a specific decision, a different standard applies. Under the Administrative Procedure Act, a court may set aside a decision made by an agency if the court finds the decision to be "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law."⁴³ When a court determines whether an agency's decision is arbitrary and capricious, it often performs a "hard look" review. During a hard look review, a court examines an agency's decision-making process to make sure an agency determination is based on relevant factors and is not a clear error of judgment.⁴⁴ Lack of an administrative record documenting how an agency came to a decision often leads to a finding that the decision is arbitrary and capricious. Similar to *Chevron* deference, though, a court may not simply substitute its judgment for the judgment of the agency.

The Supreme Court endorsed hard look review in *Motor Vehicle Manufacturers Association of the United States, Inc. v. State Farm Mutual Auto Insurance Co.*⁴⁵ The Supreme Court wrote in *State Farm* that a decision by a federal agency is arbitrary and capricious “if the agency has relied on factors which Congress has not intended it to consider.” The court also wrote that a decision will be found arbitrary and capricious if the agency “entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.” Consequently, an agency decision must be the product of “reasoned decisionmaking,” and contain a “rational connection between the facts found and the choice made.”

When it comes to agency decision making that involves science, however, hard look review tends to be considerably softer. In *Baltimore Gas & Electric Co. v. Natural Resources Defense Council, Inc.*, the Supreme Court stated that when reviewing a scientific determination made by a federal agency, “a reviewing court must generally be at its most deferential.”⁴⁶ In the *Marita* case discussed earlier, the court cited the *Baltimore Gas* case in explaining why it was deferring to the scientific determination made by the Forest Service, that conservation biology principles did not necessarily apply to forests in the Lake States. Although it may seem reasonable for a court to defer to the scientific expertise of an agency, such deference may cause a problem discussed earlier in the chapter. When agencies know that courts are particularly deferential to science, the agencies are incentivized to make every decision appear to be a scientific decision, even ones that are mainly policy decisions.⁴⁷ Consequently, both Congress and the courts have indirectly encouraged federal agencies to make policy decisions under the guise of science. More recently, there seems to be evidence that courts have begun to move away from giving extreme deference to scientific decisions.⁴⁸ Courts certainly still give considerable deference to scientific decisions, but a move away from extreme deference and toward hard look review will likely make it more difficult for federal agencies to continue hiding policy decisions behind science.

ECOLOGY AND THE LAW

Ecologists attempt to understand nature as an interdependent web of connections.⁴⁹ There is a realization that what happens at one level of organization, from genes to ecosystem to landscape, and at one time scale, from

seconds to centuries, affects all other levels of organization and time scales. Environmental law, conversely, attempts to resolve specific problems occurring in the present, with little thought given to how those problems influence the wider interdependent system in the present or over long time scales.⁵⁰

The narrow focus of the law can be seen in the organization of environmental statutes. Environmental statutes tend to concentrate on one medium, such as water in the Clean Water Act, or level of organization, such as species in the Endangered Species Act. Environmental statutes also tend to require the management of ecosystems for one or a handful of species, such as marine mammals under the Marine Mammal Protection Act, or commercial fish stocks under the Magnuson-Stevens Act.⁵¹ Environmental statutes implicitly assume that regulation of one medium or management for one species can be separated from the surrounding environment in which that medium or species exists. Of course, the interconnectedness of ecosystems makes this impossible. Consequently, the effects of environmental statutes tend to ripple out from the species or medium that is the focus of the law. As will be discussed frequently in the rest of this book, environmental statutes are bad at anticipating or dealing with the consequences of those ripples.

Because of the fundamentally different way in which ecology and environmental law understand and deal with the complexity of the natural world, there will always be friction between the two disciplines. Hopefully, continuing ecological research will help identify when and how environmental laws fall short of protecting the environment, and suggest ways to improve them. Research that shows how the effects of environmental statutes spread through the complex connections within and between ecosystems is particularly important. While environmental statutes tend to have a narrow focus, ecological research is one of the most important drivers in opening up that focus.