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Endangered species: The eye of the storm*

M.L. Corn**

Congressional Research Service — ENR, Library of Congress, Washington, DC 20540 (USA)

Abstract

The Endangered Species Act (ESA) is arguably the strongest of all U.S. environmental laws: It can just say no. In contrast to other laws that require only a balancing act, the ESA may stop a wide range of activities, including any activity requiring Federal permits, contracts, actions, loans, loan guarantees, etc. In the vast majority of cases, the mere *threat* of the ESA's power produces the desired result: A modification of an action to produce an environmentally less damaging result. Moreover, a severe problem with ESA can be a symptom of other problems underlying a project. All experience to date points to one major lesson for regulators and planners: factor in endangered species considerations at the earliest phase of project design. If an endangered species controversy arises after a project is in progress, work with the responsible Federal agency to develop the "reasonable and prudent" alternatives required by ESA. Above all, planners should not realistically expect to escape the ESA's strictures.

1. Introduction: The croaking of frogs

This planet faces not only an ozone crisis, but also a world-wide frog crisis. From the golden toad of Costa Rica to the stomach-brooding frog of eastern Australia, frogs (and other amphibians) are disappearing. These two species have gone from locally abundant to apparently extinct in barely a decade. The Australian frog was discovered in 1974; at the time, a scientist could find as many as 100 animals in a single night. The species has not been seen in the wild since the early 1980s. The golden toad is equally imperiled. Closer to home, back in the 1960s, it was easy to find the beautiful green masses of *Ambystoma maculatum* salamander eggs in the shallow ponds of central and southern Ohio. Now, those eggs are very difficult to find. Even closer to Washington, the nearby Shenandoah salamander is endangered.

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Amphibians (frogs, toads, and salamanders) as a group are not a flash in the evolutionary pan, like pterosaurs, nor newcomers like hominids — they have been on this planet for 400 million years. But according to Marc Hayes, a herpetologist at the University of Miami, only a few dozen of the 3000–4000 known species are flourishing.

The world-wide amphibian crisis is most disturbing because it is so difficult to explain. Some species, like the salamanders in Ohio, may be hurt by pH changes. The tailed frog of Washington State's Olympic Peninsula is threatened by habitat loss and fragmentation. Other species are threatened by over-collecting. These include the frogs of southern Asia destined for European tables. But certainly no one change or group of changes can explain all of these declining populations.

Two factors could help explain the frog crisis. First, most amphibians have an aquatic phase, followed by an adult terrestrial phase in which they eat mosquitoes, flies, spiders, etc. These two phases could leave amphibians susceptible to even more types of pollution than other species. Second, amphibians meet part of their respiratory needs through their skins. This permeable skin could leave them unusually sensitive to environmental contamination. Even so, some frogs — such as golden toad — live in apparently undisturbed areas, and there is no known reason for their incredible demise.

Frogs and salamanders are not nearly such charismatic megafauna as pandas, elephants, or spotted owls. Why should anyone care about Kermit the Frog? One obvious reason, clearly, is to avoid a glut of the biting insects, and the diseases (of humans and other species) these insects carry. In addition, in some areas the frogs are eaten, either by humans or by other species. More dramatically, some species of frogs may become sources of pharmaceuticals. Spande and his colleagues at the National Institutes of Health isolated a compound they called "epibatidine" (Fig. 1) from the skin of an Ecuadorian frog named *Epipedobates tricolor* [1]. The substance is a pyridine ring with a chlorine atom opposite a six carbon ring with a nitrogen bridge. The compound has three striking features: (1) it is from an entirely new class of alkaloids; alkaloids are more often found in plants than animals; (2) it is an organochlorine, which is very rare in animals; and (3) it is a powerful painkiller,

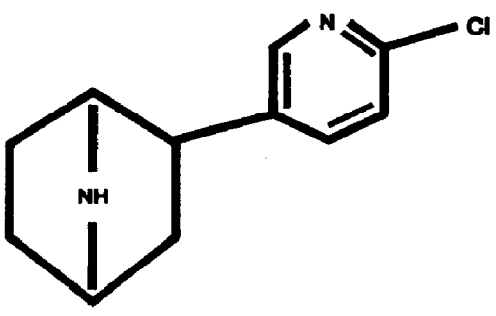

Fig. 1. Epibatidine, a pain-killing extract from the Ecuadorian frog *Epipedobates tricolor*.

about 200 × as powerful as morphine. Furthermore, bioassays on mice suggest that the compound may somehow be affecting previously unknown receptors in the brain.

2. Intelligent tinkering

One of the great conservation writers of this century, Aldo Leopold, said that the first rule of intelligent tinkering is to save all of the pieces. What frightens biologists today is the rate at which we are throwing away the pieces. It is true that extinction is normal and natural, just as the oxidation of iron to form rust is normal and natural. But just as the rapid oxidation of pure hydrogen in your living room is a real cause for concern or even panic, so too is rapid extinction of species. One leading theorist, E.O. Wilson of Harvard University, has estimated that the current extinction rate is roughly 17,000 species per year, or 1 of every 1000 species per year [2]. That rate is 1000 to 10,000 times greater than before human intervention.

Here one must separate the biological community from popular opinion: biologists are not focussed primarily on "charismatic megafauna", or creatures with soft brown eyes. If anything, it is the reverse. Biologists are especially concerned about the rapid loss of organisms most people would not hesitate to squash, if they could see them at all. Small things rule the world in mass and volume, and the complete loss of two or three species of termites would cause far more lasting damage to the plains of Africa than the complete extermination of the African elephant.

Unfortunately, elephants have better press agents than termites do, and "Save the kangaroos" is a better rallying cry than "Save the krill, the small shrimp-like animal that is the keystone of the Antarctic food chain". However, by saving elephant, kangaroo, or whale habitat, the termites, grasses, krill, frogs and other minifauna and flora may be preserved as well. So with some misgivings, biologists began making common cause with environmentalists, especially during various battles over the Endangered Species Act (ESA).

3. The Endangered Species Act of 1973

The passage of the ESA in 1973 [3] was remarkable for several reasons. First, in contrast to previous Federal laws, it explicitly protected plant and animal species generally against habitat loss, under a variety of circumstances, if not universally. Second, the Act had real teeth — some outcomes were forbidden. Third, it required all Federal agencies to use their authorities to further the purposes of the Act.

Each of these reasons affects regulated chemists. The emphasis on habitat means that the Act goes beyond forbidding the mere killing of rare species,

which is actually very rarely a problem for most domestic species. Instead, the location and manner of all sorts of activities took on great importance, and therefore began to affect chemists and the chemical industry more broadly.

The fact that some outcomes are essentially forbidden makes the ESA arguably the strongest environmental law. ESA essentially prohibits actions that would jeopardize the continued existence of species protected under the Act. By contrast, the National Environmental Policy Act (NEPA), does not forbid any particular outcome of an action — it merely requires that all outcomes be considered and analyzed. Nothing in NEPA flatly prevents an agency from choosing an outcome that would produce an unfavorable cost–benefit ratio, pollute a vast aquifer, or destroy thousands of acres of prime farmland.

This prohibition of certain outcomes is undoubtedly why ESA is constantly in the headlines. Anyone opposed to a particular project immediately tries to determine whether any protected species might be harmed by the project. Similarly, any sensible lawyer protecting the interests of neighbors of a chemical plant hopes to find listed species in the area. Obviously the argument that a certain group is "using" the ESA to achieve other goals is accurate. In the "spotted owl" debate, for example, all sides agree that the owl is only the symptom of the larger concern over the ecosystem. However, the U.S. does not have strong laws protecting entire ecosystems, so the ESA is a major tool for environmentalists. The record of this Act also suggests that had Congress been fully aware of the great reach of the ESA, the Act might not have become law in that form. Only five years after the Act first became law, Congress amended it to provide a method for exempting projects on economic grounds. (However, due to its difficulty, that method has been used only three times since 1978.)

Because the ESA requires Federal agencies to use their authorities to further the purposes of the Act, the ESA has a very broad reach. Every Federal agency, from the Environmental Protection Agency to the Federal Highway Administration, could become an enforcement agent for the Act, as it issues permits, holds timber sales, licenses TV stations, or directs airplanes.

There is an assumption imbedded in the ESA that many biologists would probably not make: the Act contemplates the "recovery" of species "to the point at which measures provided pursuant to this Act are no longer necessary." In the public arena, some have criticized the ESA as failing to restore more species to full recovery. Yet most biologists would probably agree that far into the foreseeable future, species that are now at a low ebb are likely to remain so, since the pressure on their habitats is likely to remain intense, if not worsen. The biological profession may well rejoice if the ESA has merely prevented more extinctions.

4. The structure of ESA

For convenience, the ESA can be divided into three basic parts: (1) listing, (2) prohibitions on taking, and (3) exceptions to the prohibition on taking.

There are other important features of this Act, but these three are at the core. Management of most species is handled through the Fish and Wildlife Service (FWS), but a few species are under the jurisdiction of the National Marine Fisheries Service (NMFS).

4.1 Listing

There is an elaborate procedure to list species under ESA. The process is one of the most open of Federal environmental laws, allowing opportunities for hearings and public comments, and for the public as well as Federal agencies to begin the listing process. Congress, through the 1982 amendments, made clear that this determination was to be based solely on the best available scientific information. The argument was that the well-being of a species was an objective fact. Other considerations, such as economic impact, should be considered in deciding what action to take, but should not be used to pre-judge a fundamentally scientific question.

A species can be listed as *endangered* ("any species which is in danger of extinction throughout all or a significant portion of its range") or *threatened* ("any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range"). This is not a numerical standard, and deliberately so, since species' ecological conditions vary so widely. For example, a population of 10,000 butterflies, all confined to one mountaintop, would clearly be at greater risk than 10,000 butterflies scattered over thousands of square miles.

The ESA makes a distinction between invertebrates and plants on the one hand, and vertebrates on the other. Vertebrate populations are protected, even if some populations are doing well. Bald eagles, for example, are protected in West Virginia even though Alaskan bald eagles are flourishing. On the other hand, monarch butterflies on the east coast would not be protected unless the west coast population was also depleted. Threatened or endangered plants receive even more limited protection. There is no scientific reason claimed for these three classes of endangered citizenship. If anything, a scientific approach would probably suggest the reverse order of priorities. Bean speculated that "although the rationale for [this distinction] is not evident, it almost certainly had less to do with any distinction between vertebrates and other life forms than with a desire to limit the number of listed taxa" [4].

4.2 Prohibition on taking

The ESA prohibits the "taking" of a listed species. Taking is defined very broadly to include not only shooting, capturing, or trapping an animal, but also any harm that would significantly modify or degrade habitat so as to significantly impair essential behavioral patterns, including breeding, feeding or sheltering. There are substantial civil and criminal penalties, including jail terms, and confiscation of property. Federal, State, and local agencies can be penalized, as can private citizens.

4.3 Exceptions to the prohibition

The prohibition on taking, given its breadth and severity, would eliminate a great variety of activities, sometimes with very little benefit, if left to stand alone. However, there are ways to obtain Federal approval for actions doing minimal harm to listed species or their habitat. First, if a Federal agency is involved, even if only through the issuance of a permit or grant, the Federal agency must consult with FWS (or NMFS) to determine whether the proposed action would jeopardize the species. If there is no jeopardy, the agency may proceed. Alternatively, FWS may suggest reasonable and prudent modifications (confining activities to daylight hours, avoiding south-facing slopes, lowering heights of structures, etc.) that could allow the project to go forward. Finally, and least likely, FWS may determine that the project cannot be carried out without jeopardizing the species.

These consultations are not as onerous as recent publicity might suggest. Over 90% of the consultations in the last five years resulted in a finding of no jeopardy. Of 18,211 formal and informal consultations, only 181 projects or actions would have jeopardized the species. Of these, 158 consultations produced reasonable and prudent alternatives to the proposed measure that would be consistent with protecting the species. Only 23 consultations produced opinions from FWS or NMFS that the projects could not be carried out without jeopardizing the listed species [5].

Second, if the action is purely private — no Federal permits, loan guarantees, etc. — and is otherwise legal, then the company or individual must ask FWS for an incidental take permit under Section 10. The requirements for such a permit are both stringent and potentially expensive. They include preparation of a habitat conservation plan and opportunities for public comment. They may be prohibitive for small companies or landowners, or too expensive for small projects.

4.4 Other elements of ESA

The ESA also provides for the designation of habitat critical to the recovery of a species. This determination, in contrast to listing, requires an economic balancing act. FWS officials in private agree that critical habitat designation provides only a small increment of additional protection for a species, and as a result have designated critical habitat for only 16% of listed species, even though a recent court decision [6] held that FWS was arbitrary and capricious when it initially failed to do so in the case of the spotted owl. The complexity of the law and regulations concerning critical habitat have been among the reasons that no critical habitat designation, once made, has ever been modified.

The ESA is the domestic implementing legislation for the Convention on International Trade in Endangered Species of Fauna and Flora (CITES). The CITES treaty is focussed almost exclusively on limiting or preventing international trade, rather than habitat loss, even though trade is problem for only a limited number of species (e.g., psitticine birds, elephants, orchids, rhinos, etc.).

In response to the famous case of the snail darter and the Tellico Dam, Congress created an exemption process in 1978 that would specifically take economic factors into account [7]. Proponents of an action or project may apply for an exemption for that action (but not for a species). A Committee (sometimes called the "God Squad") of six specified Federal officials and a representative of the affected State(s) must decide whether to allow a project to proceed in spite of future harm to a species. At least five votes are required to pass an exemption. The Act included stringent criteria that must be applied to grant an exemption. Interestingly, in its most famous proceeding, and after taking economics into account, the Committee voted unanimously in favor of the fish and against the dam. The dam was completed only because Congress later overrode the Committee's decision.

One important problem leading to the loss or depletion of many species is not covered in the Act: the introduction of non-native species. While the ESA would permit attention to non-native species as a means of addressing the problems of listed species, the Act has not been a vehicle for preventing such introductions in the first instance. In some places, such as Hawaii, these exotic species are probably the leading cause of species loss. Important examples of this problem include the introduction of avian malaria in Hawaii, of Dutch elm disease and chestnut blight on the mainland, of zebra mussels in the Great Lakes, and the brown tree snake into Guam, a U.S. possession in the Pacific. The problem is getting increased attention, and a major report from the U.S. Office of Technology Assessment is expected later this year (1993), but outside of the problem in Hawaii and the problems resulting from the introduction of zebra mussels, this issue has received little congressional attention to date.

5. Lessons for managers

If only one piece of advice can be given to chemists managing waste plants, manufacturing facilities, or a new university laboratory in the U.S., it is this: If there is any chance that a listed species might be involved in your project, then consult with FWS (or NMFS) early, and as often as necessary. Later on, the ESA, with its many options for citizen lawsuits, can stop a program completely. If there is a problem, it is best to know at the earliest stages when modifications would be inexpensive, or at least less costly than at a later time. In some areas, maps of endangered species' habitats have been incorporated into geographic information systems, and these might be used to site facilities. Examples of such areas include the Chesapeake Bay watershed, much of Connecticut, and parts of Oregon. No doubt more could be found.

A second lesson derives from the great popularity of the ESA. A bipartisan polling team conducted a survey on the ESA in mid-December 1991, in the midst of a recession [8]. Of the voters surveyed, 66% supported the ESA, 40% strongly so. Support of the ESA crosses boundaries of region (e.g., 69% in

Rocky Mountain states), income (52% of voters earning less than $10,000 per year), and party (65% of Republicans and Independents, 66% of Democrats).

One survey question was particularly direct: "When you hear a news story about how some local industry is being hurt by laws protecting a bird, fish, plant, or animal [mammal], do you find that your sympathies are usually more with protecting the wildlife or more with protecting the local businesses and jobs?" Wildlife was preferred by 48%, while businesses and jobs got 29%. Moreover, 73% would consider a Senator's strong stand in favor of endangered species as a reason to support that candidate, and nearly a third of these would consider it a very important reason.

Some corporations even use their assistance to a listed species as an asset [9]. Waste Management Inc. (WMI) in San Jose, California, faced with the presence of the Bay checkerspot butterfly (*Euphydryas editha*) on its property, used the butterfly as an opportunity to put its best environmental foot forward. That butterfly now has its own preserve created by WMI, the butterfly is the mascot of its 800 acre landfill, and the butterfly appears on the logo of the company's garbage trucks. At the same time, another company, United Technologies Corporation, fought the designation of the butterfly as endangered, and appears to have spent more fighting the listing than WMI did in reaping its publicity benefits. A project manager who decides to fight the ESA in the courts, in the regulatory process, or in the political arena, is facing a tremendous uphill struggle. A motto for a cost-effective alternative strategy is "consult early and often."

The world-wide frog crisis is only one cause of the nervous concern with which most biologists now view the planet's living resources. The 18th century poet William Blake [10] wrote: "To see the world in a grain of sand,/And heaven in a wild flower;/Hold infinity in the palm of your hand,/And eternity in an hour." More prosaically, the biological profession probably sees the world in the skin of a frog, and heaven in a rain forest. But the message it might send the rest of the country is that the palm — however imperfect — that holds the infinity of evolution may be the Endangered Species Act. For at least this hour of eternity.

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