

COMMENTS

THE APPLICATION OF THE ENDANGERED SPECIES ACT TO THE PROTECTION OF FRESHWATER MUSSELS: A CASE STUDY

BY
ERIC BIBER*

Freshwater mussels are the most endangered group of animals in the United States, and the success or failure of the Endangered Species Act (ESA) in protecting mussels provides an important case study of the overall strengths and weaknesses of the Act. The case study is based on 1) interviews with United States Fish and Wildlife Service biologists in charge of enforcing the Act with respect to mussels and with conservation biologists who have extensively studied freshwater mussels, 2) recovery plans, listing documents, and biological opinions created by the Fish and Wildlife Service as part of its implementation of the Act, and 3) quantitative data on recovery and listing efforts for mussel species. Based on this data, this Comment concludes that the Act is being substantially under-enforced with respect to mussels, especially in the areas of designation of critical habitat and section 9's prohibition on takings, and that the Act has had very limited success in restoring mussel populations. These results are due to 1) delayed recovery efforts for many mussel species, 2) gaps in the law that leave species vulnerable to aquatic pollution, and 3) a systematic bias against the protection of invertebrates. The case study thus shows that, contrary to one of the standard criticisms of the ESA, the administration of the Act already prioritizes enforcement and recovery efforts among various species based on perceived social value. The stringent requirements of the ESA may be essential to ensuring that species such as mussels receive even the limited protection they currently enjoy.

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I. INTRODUCTION

The Endangered Species Act (ESA or Act)¹ remains one of the most controversial environmental laws in the United States. Supporters depict it as the only legal bulwark against the mass extinction of species in the United States and the destruction of threatened ecosystems essential to the survival of natural biological systems.² Opponents depict it as a misguided law that has failed to achieve its objectives of protecting and conserving endangered species, and that has created hostility towards its goals among the private landowners who are crucial to efforts to preserve biodiversity.³

This Comment examines the success or failure of the ESA in protecting a particular group of endangered species: freshwater mussels. Freshwater mussels constitute a substantial portion of the species listed as threatened or endangered under the ESA, and moreover, are the most endangered taxonomic group of species that scientists are aware of in the United States.⁴ As such, they represent a group that should be a focus of conservation efforts under the Act, if the goal is the preservation of all species, regardless of economic, aesthetic, or social value. Mussels are also a group that has

¹ Endangered Species Act of 1973, 16 U.S.C. §§ 1531–1544 (2000).

² See, e.g., ENVTL. DEF. FUND, *REBUILDING THE ARK: TOWARD A MORE EFFECTIVE ENDANGERED SPECIES ACT FOR PRIVATE LAND* (1996) [hereinafter *REBUILDING THE ARK*] (concluding that the ESA has been successful); WILLIAM J. SNAPE II & ROBERT FERRIS, *SAVING AMERICA'S WILDLIFE: RENEWING THE ENDANGERED SPECIES ACT* (1995) (describing the success of the Act).

³ See, e.g., NAT'L WILDERNESS INST., *CONSERVATION UNDER THE ENDANGERED SPECIES ACT: A PROMISE BROKEN* (1997) [hereinafter *A PROMISE BROKEN*] (arguing that the focus on conservation programs inhibits reaching the goal of conservation); CHARLES C. MANN & MARK L. PLUMMER, *NOAH'S CHOICE: THE FUTURE OF ENDANGERED SPECIES* (1995) [hereinafter *NOAH'S CHOICE*] (questioning the means to the goals of the Act); Ike Sugg, *Caught in the Act: Evaluating the Endangered Species Act, Its Effects on Man, and Prospects for Reform*, 24 CUMB. L. REV. 1 (1993) (arguing that the ESA is too broad).

⁴ See discussion *infra* Part II.

almost been entirely ignored in the legal literature's analysis of the Act,⁵ and therefore represent an understudied area in the analysis of the Act's success or failure.

This Comment begins with an overview of the biology and status of freshwater mussels (Part II), and then provides a detailed survey of the current human threats to the survival of freshwater mussel species (Part III). Part IV gives a short overview of the ESA and the tools the Act provides that might be used to protect and restore freshwater mussel species. Part V discusses the current legal and regulatory efforts by the United States Fish and Wildlife Service (the Service or FWS), the federal agency responsible for the application of the ESA to protect freshwater mussels, and discusses the current success of those enforcement and recovery efforts. Part VI summarizes the legal, policy, and biological literature analyzing why the ESA may be unsuccessful. Part VII assesses the conclusions of the legal literature, and discusses possible reasons for the success or failure of the ESA in the context of freshwater mussels.⁶

This case study reveals that, while the ESA has prevented the extinction of most species of freshwater mussels, nonetheless many, if not most, freshwater mussel species remain critically endangered and declining. This Comment concludes that the inability of the ESA to provide for the recovery of freshwater mussel species is due to three factors: 1) the near-impossibility of recovering a species after most of its habitat has been destroyed and its populations eliminated; 2) underlying flaws in the ESA that make it much more difficult to address the threats to endangered freshwater aquatic species; and 3) a persistent and substantial historic bias against funding and enforcement of the ESA to protect freshwater mussel species. To provide for greater protection of freshwater species such as mussels, the ESA may need to adopt provisions similar to that of the Clean Water Act (CWA),⁷ or alternatively, the CWA may need to be implemented in a manner that is more protective of endangered species. This case study of freshwater mussels not only reveals some fundamental areas of needed reform for the ESA, but also the broader importance of using environmental laws that have absolute theoretical mandates (such as the ESA's requirement that all species be saved) to ensure that otherwise ignored environmental harms are addressed.

II. BASIC BIOLOGY AND CONSERVATION STATUS OF FRESHWATER MUSSELS

Freshwater mussels are similar to the saltwater or estuary mussels that

⁵ Indeed, one recent legal study of the success or failure of the ESA in recovering endangered species explicitly excluded freshwater mussels from its analysis. Jeffrey J. Rachlinski, Book Review, *Noah by the Numbers: An Empirical Evaluation of the Endangered Species Act*, 82 CORNELL L. REV. 356 (1997).

⁶ To obtain detailed and current information about the application of the ESA to freshwater mussels, I interviewed a number of government and academic biologists who specialize in freshwater mussels or who help implement the ESA with respect to freshwater mussels.

⁷ Federal Water Pollution Control Act, 33 U.S.C. §§ 1251-1387 (1994 & Supp. III 1997).

are familiar to any lover of seafood—they are mollusks,⁸ and are protected by a hardened shell made of calcium and other minerals, with an interior soft body that contains all vital organs. The exterior shells (or “valves”) protect the animal against predators, and a muscular foot on the rear underside of the animal can extend between the valves allowing it to move as necessary. On the other side of the animal, two siphons allow the mussel to take in and expel water, and gills to take up oxygen extend on either side of the animal, poking out through the valves except in situations of extreme danger.⁹ Mussels are filter feeders, consuming the algae and other organic materials they trap as they siphon water from the water column.¹⁰

While mussels can move with their foot, their rate of movement is limited, and they tend to remain in one location for extended periods of time—adults are always partly embedded in the bottom of some body of permanent water.¹¹ The requirement of remaining embedded in the bottom (substrate) of the water body means that the substrate characteristics (sandy, silty, gravelly, etc.) and the depth of the water can be essential factors in determining where mussels will settle and grow.¹²

⁸ The taxonomic classification of freshwater mollusks is as follows: mollusks are members of the Kingdom *Animalia*, Phylum *Mollusca*, Class *Bivalvia*.

⁹ PAUL W. PARMALEE & ARTHUR E. BOGAN, *THE FRESHWATER MUSSELS OF TENNESSEE* 6–7 (1998).

¹⁰ ROBERT T. DILLON, JR., *THE ECOLOGY OF FRESHWATER MOLLUSCS* 9–19 (2000); Albert J. Burky, *Physiological Ecology, Freshwater Bivalves*, 6 *MOLLUSCA* 281, 292–94 (1983); E.P. Churchill, Jr. & Sara I. Lewis, *Food and Feeding in Freshwater Mussels*, 39 *BULL. U.S. BUREAU OF FISHERIES* 439, 439 (1924). The amount of water filtered by freshwater mussels can be significant. See David L. Strayer et al., *Abundance, and Roles of Freshwater Clams (Bivalvia, Unionidae) in the Freshwater Tidal Hudson River*, 31 *FRESHWATER BIOLOGY* 239, 242–43 (1994) (noting that mussels in the Hudson River estuary filter the same amount of water as is carried downstream in the river).

¹¹ PARMALEE & BOGAN, *supra* note 9, at 6.

¹² As a result, many species' habitats are defined by the substrate characteristics that scientists believe determine the suitability of the habitat. See, e.g., U.S. FISH AND WILDLIFE SERV., *CRACKING PEARLYMUSSEL RECOVERY PLAN 1* (1990) [hereinafter *CRACKING PEARLYMUSSEL RECOVERY PLAN*] (defining habitat based on substrate); U.S. FISH AND WILDLIFE SERV., *CAROLINA HEELSPLITTER RECOVERY PLAN 1–2* (1996) [hereinafter *CAROLINA HEELSPLITTER RECOVERY PLAN*] (same). However, attempts to use substrate characteristics to predict the location of mussels and the suitability of their habitat have not been very successful. See, e.g., David L. Strayer, *Notes on the Microhabitats of Unionid Mussels in Some Michigan Streams*, 106 *AM. MIDLAND NATURALIST* 411, 413 (1981); Strayer et al., *supra* note 10, at 239. Other research has found that water depth, velocity, and surface geology, as well as substrate, may be significant in determining suitability of habitat. See David L. Strayer, *Use of Flow Refuges by Unionid Mussels in Rivers*, 18 *J. N. AM. BENTHOLOGICAL SOC'Y* 468, 468 (1999) (hypothesizing that stable areas of the riverbed are the best mussel habitat); John Mark Hanson et al., *The Effects of Water Depth and Density on the Growth of a Unionid Clam*, 19 *FRESHWATER BIOLOGY* 345, 352–54 (1988); Anneke Salmon & Roger H. Green, *Environmental Determinants of Unionid Clam Distribution in the Middle Thames River, Ontario*, 61 *CANADIAN J. ZOOLOGY* 832, 837 (1983) (finding increased frequency of clams in slow moving, shallow water, and coarse substrate); David Strayer, *The Effects of Surface Geology and Stream Size on Freshwater Mussel (Bivalvia, Unionidae) Distribution in Southeastern Michigan, U.S.A.*, 13 *FRESHWATER BIOLOGY* 253, 261–63 (1983) (finding stream size and surface geology are two major environmental features that control the distribution of 34 species of unionid mussels living in southeastern Michigan streams); DILLON, *supra* note 10, at 22–28 (finding mussel density peaks rapidly then falls

The life cycle and reproduction of North American freshwater mussels is complex and unique. Male mussels will release clouds of sperm into the water column, which fertilize female mussels; the female mussels then release an enormous number of juvenile mussels, called "glochidia." The glochidia will float in the water column, but will perish or be consumed in a very short time unless they encounter a fish. The glochidia then attach themselves to the fish and parasitically live off of the fish (usually causing little or no harm) until they have developed to the juvenile mussel stage.¹³ The juvenile mussels then break off of the fish and settle onto the bottom of the river, stream, or lake to begin an independent life. They will then develop into adult mussels.¹⁴

The odds against any one individual glochidium surviving are extremely large—thousands or millions of glochidia may be produced, but the vast majority never encounter a fish.¹⁵ Moreover, some species of mussels can only parasitize a particular fish species—the specificity of the mussel/host fish relationship reduces the odds that a glochidium will successfully attach to a fish.¹⁶ And once the juvenile mussel has been released from the host fish, the odds against the juvenile mussel finding appropriate substrate to settle upon are also high.¹⁷

However, once a freshwater mussel has successfully colonized suitable habitat, it can live for decades (depending on the species)¹⁸ and will have many years of successful reproduction (although success will often be highly variable).¹⁹ Thus, mussel species tend to have a very low rate of population increase, but very stable populations (assuming there are not major changes in the environment).

Freshwater mussels are taxonomically identified in large part based on shell characteristics.²⁰ Most freshwater mussels in the United States are classified as members of the order *Unionoidea* (called "Unionids"). There

gradually as depth increases).

¹³ PARMALEE & BOGAN, *supra* note 9, at 7–8; Burky, *supra* note 10, at 298–99; DILLON, *supra* note 10, at 38–45. Some mussel species go to great lengths to make their glochidia more likely to attract fish—the glochidia remain attached to the female mussel and are contained in a large mass that resembles a minnow or other small prey fish. Large predatory fish attack the glochidial mass and are infested by the glochidia. In other mussel species, the female mussels have specially adapted body parts that resemble minnows (just like fishing lures) in order to draw predatory fish in to be infected. Wendell R. Haag & Melvin L. Warrin Jr., *Mantle Displays of Freshwater Mussels Elicit Attacks from Fish*, 42 FRESHWATER BIOLOGY 35, 38–39 (1999); Wendell R. Haag et al., *An Extraordinary Reproductive Strategy in Freshwater Bivalves: Prey Mimicry to Facilitate Larval Dispersal*, 34 FRESHWATER BIOLOGY 471, 471–72 (1995).

¹⁴ PARMALEE & BOGAN, *supra* note 9, at 8.

¹⁵ *Id.*

¹⁶ *Id.*; DILLON, *supra* note 10, at 46–51.

¹⁷ One estimate places the odds of survival of glochidia to adulthood and reproduction at five million to one. Burky, *supra* note 10, at 303.

¹⁸ See Joseph Heller, *Longevity in Molluscs*, 31 MALACOLOGIA 259, 260 (1990) (noting that some mollusks can live 200 years).

¹⁹ Barry S. Payne & Andrew C. Miller, *Growth and Survival of Recent Recruits to a Population of *Fusconaia ebena* (Bivalvia: Unionidae) in the Lower Ohio River*, 121 AM. MIDLAND NATURALIST 99, 99 (1989).

²⁰ PARMALEE & BOGAN, *supra* note 9, at 9.

are currently 297 species of Unionids historically known from North America, of which nineteen are presumed extinct,²¹ sixty-one are listed as endangered by the Service,²² and eight are listed as threatened.²³ These numbers probably underestimate the true proportion of freshwater mussel species that are in danger of extinction—scientists estimate that seventy percent of all freshwater mussel species are endangered, threatened, or of special concern, and only about twenty-four percent are considered stable.²⁴

III. THREATS TO MUSSELS

Freshwater mussels face an enormous range of threats, from direct overharvesting by humans and predation by other animals, to direct habitat destruction by humans, to indirect habitat degradation by human activities, to impacts from newly introduced exotic species.²⁵ This Part summarizes those threats, and also provides an assessment of how serious those threats are, an assessment based in part on interviews with biologists.

²¹ Arthur E. Bogan, *Freshwater Bivalve Extinctions (Mollusca: Unionoida): A Search for Causes*, 33 AM. ZOOLOGIST 599, 599 (1993).

²² U.S. Fish and Wildlife Serv., *Threatened and Endangered Species System (TESS), U.S. Listed Invertebrate Animal Species Report by Taxonomic Group as of 10/31/2001*, at <http://ecos.fws.gov/webpage> (last visited Oct. 31, 2001).

²³ *Id.*

²⁴ James D. Williams et al., *Conservation Status of Freshwater Mussels of the United States and Canada*, 18 FISHERIES 6, 6 (1992); see also Will Nixon, *The Species Only a Mother Could Love*, AMICUS J., Summer 1999, at 28, 29 (noting that 70% of freshwater mussels are at risk of disappearing); Bogan, *supra* note 21, at 603 (explaining that 44 taxa of unionid bivalves are listed as federally endangered or threatened); Richard J. Neves, *Conservation and Commerce: Management of Freshwater Mussel (Bivalvia: Unionoidea) Resources in the United States*, 41 MALACOLOGIA 461, 462–63 (1999) [hereinafter Neves, *Conservation and Commerce*] (stating that 23% of freshwater mussel species are included on the endangered species list). These numbers are not unusual for North American freshwater fauna, which in general have faced high extinction rates. However, mussels appear to have historically faced the highest extinction rates, and appear to face the highest rates in the future. Anthony Ricciardi & Joseph B. Rasmussen, *Extinction Rates of North American Freshwater Fauna*, 13 CONSERVATION BIOLOGY 1220, 1221 & tbl.1 (1999) (finding that freshwater fauna have a projected future extinction rate five times higher than for terrestrial fauna, that rates of predicted North American freshwater fauna extinctions equal those predicted for tropical forest species, and that mussels have the highest extinction rates in recent history among all freshwater faunal taxonomic groups and will have a future extinction rate almost twice as high as the next highest freshwater faunal taxonomic group—a 6.4% loss per decade).

²⁵ “Exotic” or “non-indigenous” species are species that historically have not been found in a particular ecosystem, but have been introduced into the area within recent history (almost always through human activities). Exotic species can have enormous impacts on “native” species (defined as species that are presumed to have existed in the ecosystem before human intervention) through direct predation, competition, transmission of diseases, or habitat alteration. Numerous extinctions throughout the world are presumed to have been due to the effects of exotic species. See generally Eric Biber, *Exploring Regulatory Options for Controlling the Introduction of Non-Indigenous Species to the United States*, 18 VA. ENVTL. L.J. 377, 378–89 (1999) (noting that exotic species have dramatic negative impacts on native species).

A. Direct Overharvesting

Freshwater mussels have historically been subject to extensive and heavy harvesting pressure from humans. Commercial harvesting first reached major levels in the late nineteenth and early twentieth century, with the development of a major market for the use of freshwater mussel shells for button manufacturing.²⁶ Harvesting soon reached extremely high levels throughout the early part of the twentieth century, and the federal government began research into the conservation and propagation of the major commercial species because of fears that harvesting pressure might lead to the depletion or extinction of mussel species.²⁷ Eventually, the button industry declined due to the advent of plastic buttons and zippers in the 1940s, but not until the populations of many mussel species had been substantially depleted.²⁸ Harvesting pressure increased in the 1950s as Japanese and other Asian pearl culture operations began using North American freshwater mussel shells as bead nuclei.²⁹ Harvesting again reached relatively high levels, particularly in the rivers and reservoirs of Tennessee and Kentucky. Since the 1950s, harvest levels have fluctuated in response to overseas demand for the shells, with another spike in harvest in the early 1990s.³⁰ The harvesting pressures have led to concern over the status of the major commercial mussel species (which are not threatened or endangered) and over the status of threatened and endangered non-commercial species that may be accidentally taken in the harvesting process.³¹ A number of states now have regulations on the time, place, and manner of mussel harvesting to protect both target and non-target species.³²

²⁶ Neves, *Conservation and Commerce*, *supra* note 24, at 467; Pamela A. Thiel & Arnold W. Fritz, *Mussel Harvest and Regulations in the Upper Mississippi River System*, in CONSERVATION AND MANAGEMENT OF FRESHWATER MUSSELS 11, 11–12 (Kevin S. Cummings et al. eds., 1993).

²⁷ Neves, *Conservation and Commerce*, *supra* note 24, at 467 (noting that the rush for shells overexploited mussel populations); Thiel & Fritz, *supra* note 26, at 12 (stating that Mississippi River mussels were thought to be doomed in the 1930s); George Lefevre & W.C. Curtis, *Experiments in the Artificial Propagation of Fresh-Water Mussels*, 28 BULL. U.S. BUREAU OF FISHERIES 615, 617 (1908).

²⁸ Neves, *Conservation and Commerce*, *supra* note 24, at 468; Thiel & Fritz, *supra* note 26, at 12.

²⁹ Neves, *Conservation and Commerce*, *supra* note 24, at 468; Thiel & Fritz, *supra* note 26, at 12–13. Bead nuclei are the foreign matter placed inside oysters that cause the oyster to produce a pearl.

³⁰ Neves, *Conservation and Commerce*, *supra* note 24, at 469–70.

³¹ Concerns about accidental take of endangered non-commercial species, particularly by inexperienced harvesters who are unable to distinguish commercial and non-commercial species, led Indiana to temporarily prohibit commercial mussel harvesting in 1991. Robert M. Anderson et al., *Why Did Indiana Halt Commercial Mussel Harvest in 1991?*, in CONSERVATION AND MANAGEMENT OF FRESHWATER MUSSELS, *supra* note 26, at 19, 20–23; see also Billy G. Isom, *The Mussel Resource of the Tennessee River*, 7 MALACOLOGIA 397, 408 (1969) (blaming decline of mussels in the 1960s in Tennessee on overharvesting).

³² Neves, *Conservation and Commerce*, *supra* note 24, at 470–73; Thiel & Fritz, *supra* note 26, at 13–14. For a survey of state regulations in the early 1990s, see generally CONSERVATION AND MANAGEMENT OF FRESHWATER MUSSELS, *supra* note 26. For varying perspectives on the threat that commercial harvesting poses to freshwater mussels today, compare Samuel L.H. Fuller, *Clams and Mussels (Mollusca: Bivalvia)*, in POLLUTION ECOLOGY OF FRESHWATER

However, most biologists interviewed for this case study did not feel that overharvesting represented a significant, widespread threat today for freshwater mussels. Overall, biologists cited as reasons for the decrease in the importance of this threat a drop in the price for freshwater mussel shell in the past few years, connected with a collapse in the Japanese pearl culturing industry, as well as improved enforcement by state and federal agencies, and increased recognition by commercial harvesters of the importance of avoiding take of listed and rare freshwater species.³³

B. Predation

Mussels are eaten by a number of animals, including mammals, birds, and fish.³⁴ However, the major source of predation has been muskrats and river otters, which will often create middens of shells they have collected in a particular area. Mussel populations that are not at extremely low levels are probably not threatened by predation, but populations already depleted by other causes may be vulnerable to extinction due to predation.³⁵ Muskrats

INVERTEBRATES 215, 251 (C.W. Hart, Jr. & Samuel L.H. Fuller eds., 1974) ("The use of scuba and other diving gear enables shellers to collect entire beds. However localized and imperfectly lethal, this may be the greatest threat to commercially valuable mussels today."), *with Neves, Conservation and Commerce*, *supra* note 24, at 472-73 ("The evidence of overharvest and depletion of mussel populations during the pearl button era has not sullied the present management regime of commercial species, nor has incidental take of rare species been shown to jeopardize the continued existence of those species."). For an example of enforcement actions against violators of state commercial harvest laws, see *United States v. Borden*, 10 F.3d 1058, 1060 (4th Cir. 1993) (upholding conviction of defendants for violation of Lacey Act for the illegal harvest and sale of freshwater mussels from the Ohio River). A fine of over \$1 million was levied in the late 1990s against a Tennessee mussel corporation for harvesting of mussels in violation of state laws and regulations. Telephone Interview with Randy Sanders, Assistant Administrator, Fish Management Research, Ohio Division of Wildlife (Apr. 10, 2001) [hereinafter Sanders Interview].

³³ Telephone Interview with Arthur E. Bogan, Curator of Aquatic Invertebrates, North Carolina State Museum of Natural Sciences (Apr. 6, 2001) [hereinafter Bogan Interview]; see also Telephone Interview with Paul Hartfield, Endangered Species Biologist, Jackson, Mississippi Field Office, U.S. Fish and Wildlife Serv. (Apr. 10, 2001) [hereinafter Hartfield Interview] (explaining that commercial harvesting industry supports enforcement of harvesting laws because of the need to manage mussels, and pointing out that industry turns in violators); Telephone Interview with William A. Tolin, Endangered Species Specialist, West Virginia Field Office, U.S. Fish and Wildlife Serv. (Apr. 12, 2001) [hereinafter Tolin Interview]; Telephone Interview with Jack Wallace, Environmental Resources Specialist, Nongame Wildlife and Natural Heritage Program, Wildlife Resources Section, West Virginia Division of Natural Resources (Apr. 13, 2001) [hereinafter Wallace Interview] (stating that mussel harvesting in West Virginia is illegal and that the state has made some arrests of poachers).

³⁴ Fuller, *supra* note 32, at 226-40.

³⁵ See Richard J. Neves & Michael C. Odom, *Muskrat Predation on Endangered Freshwater Mussels in Virginia*, 53 J. WILDLIFE MGMT. 934, 934-40 (1989) (noting that muskrats appeared to be selectively and heavily predating an endangered mussel species, and proposing the use of trapping to reduce muskrat pressure on these populations). The historic coexistence of muskrats, river otters, and other predators with mussel populations indicates that this predation pressure should generally not be sufficient to lead to the extinction or endangerment of mussel species. See Final Rule to List the Ouachita Rock-Pocketbook (Mussel) as an Endangered Species, 56 Fed. Reg. 54,950, 54,953 (Oct. 23, 1991) (codified at 50 C.F.R. § 17.11(h))

have been observed consuming endangered and threatened mussel species. In areas where native mussels have been supplanted by exotic species, such as the zebra mussel or the Asian clam, those species appear to dominate the diet of predators, which might reduce the predation pressure of muskrats on rare and endangered species.³⁶ Biologists currently do not consider muskrat predation to be a major threat to populations of endangered species, except in a few locations.³⁷

C. Direct Habitat Destruction

A number of human activities have led to the direct destruction of mussel habitat, which, as noted above, usually is a free-flowing stream or river with a sandy or gravel substrate.

1. Gravel Mining and Dredging

Because mussels are sessile (non-moving) organisms that inhabit the substrate of rivers and streams, they are extremely vulnerable to human activities that disturb, transfer, or eliminate that substrate. Mussels in particular prefer gravel and sand substrate, making them vulnerable to activities such as gravel and sand mining (often for building material and concrete ingredients) that involve the removal of large amounts of substrate from the river. Gravel and sand mining can be geographically extensive and significant, and have been implicated in the decline of a number of mussel species.³⁸ Because mussels cannot move particularly far or fast, they are often unable to escape before being removed, crushed, or otherwise damaged by the sand and gravel mining. Even if the mussels are not directly destroyed, the mining activity usually significantly changes the substrate in a manner that renders it unsuitable. If the particular habitat the mussels inhabit is not directly affected by the sand and gravel mining, erosion—in the form of the development of “headcuts”³⁹ that travel over time up the

(2000)) (“The river otter was once a natural component of the riverine ecosystems of eastern Oklahoma and Arkansas, and apparently coexisted with the Ouachita rock-pocketbook before settlement, without eliminating that species.”).

³⁶ Neves & Odom, *supra* note 35, at 939.

³⁷ Tolin Interview, *supra* note 33.

³⁸ John E. Schmidt et al., *Historical Changes in the Mussel Fauna (Bivalvia: Unionoidea) of the Stones River, Tennessee*, 22 MALACOLOGICAL REV. 55, 57 (1989); see also Bogan, *supra* note 21, at 604; Jayne Brim Box & Joann Mossa, *Sediment, Land Use and Freshwater Mussels: Prospects and Problems*, 18 J. N. AM. BENTHOLOGICAL SOC'Y 99, 103–04 (1999); David H. Stansbery, *Eastern Freshwater Mollusks (I) The Mississippi and St. Lawrence River Systems*, 10 MALACOLOGIA 9, 9–10 (1970); Determination of Threatened Status for the Inflated Heelsplitter, *Potamius Inflatus*, 55 Fed. Reg. 39,868, 39,870 (Sept. 28, 1990) (codified at 50 C.F.R. § 17.11(h) (2000)) (noting that 30% of a species's habitat on the Amite River has been destroyed by gravel mining and that gravel mining is one of the main threats facing this species); Louise Russert Kraemer, *Corbicula (Bivalvia: Sphaeriacea) vs. Indigenous Mussels (Bivalvia: Unionoidea) in U.S. Rivers: A Hard Case for Interspecific Competition?*, 19 AM. ZOOLOGIST 1085, 1092 (1979) (describing how mining decreases mussel habitat).

³⁹ Headcuts are sharp drops in the river gradient that are caused by human activities that dredge, dig, or otherwise lower the level of the river significantly at a particular point. Because

river channel—can cause extensive habitat destruction for miles upstream from the gravel and sand mining location.⁴⁰

The dredging of rivers to create and maintain navigation channels obviously has much the same initial impact as the gravel mining—the direct killing and injury of mussels in the dredge area and the elimination of suitable substrate habitat for the mussels. Dredging and other channel modifications to rivers have been identified as significant causes of mussel declines in the United States.⁴¹

2. Impoundments and Channelization

Mussels often require particular water flows to survive. Some species specialize in lentic (slow water) flows, such as lakes, and significantly more specialize in lotic (fast water) flows, such as rivers and streams. In the past century, human activities in North America have led to enormous changes in the type of flow experienced along most rivers and streams. The most dramatic changes are those caused by the construction of dams and the creation of reservoirs, which have changed hundreds and hundreds of miles of North American rivers and streams from fast-flowing to slow-flowing environments. The mussel populations that have adapted to the fast-flowing currents of rivers that previously existed either die from direct mortality due to the change in flow regime or more often become “senescent,” unable to reproduce. The mortality and reproductive failure of mussels in reservoirs has been traced to a number of causes, including siltation, which causes direct mortality,⁴² elimination of critical host fish species that can no longer tolerate the new reservoir flow conditions, reduced dissolved oxygen at the significantly deeper water depths, reduced temperatures at the deeper water depths, disease, and the inability of juvenile mussels to find suitable substrate in the much siltier and muckier bottom of the reservoir.⁴³ While

of the action of erosion as the water falls over the new headcut (a kind of small waterfall) on the erodable substrate, headcuts can often move rapidly upstream over time, causing significant erosion and change in substrate in the river or stream channel.

⁴⁰ Paul Hartfield, *Headcuts and Their Effect on Freshwater Mussels*, in CONSERVATION AND MANAGEMENT OF FRESHWATER MUSSELS, *supra* note 26, at 131.

⁴¹ David C. Aldridge, *The Impacts of Dredging and Weed Cutting on a Population of Freshwater Mussels (Bivalvia: Unionidae)*, 95 BIOLOGICAL CONSERVATION 247, 247 (2000); Box & Mossa, *supra* note 38, at 104. *But see* Determination of Endangered Status for Five Freshwater Mussels and Threatened Status for Two Freshwater Mussels from the Eastern Gulf Slope Drainages of Alabama, Florida and Georgia, 63 Fed. Reg. 12,664, 12,676–77 (Mar. 16, 1998) (codified at 50 C.F.R. § 17.11(h) (2000)) (comments by the Corps of Engineers in reaction to listing of species, arguing that dredging is not harmful to freshwater mussels, or at least is less harmful than other potential threats, including runoff).

⁴² The change from fast to slow current by the river results in the deposition of large amounts of silt in the reservoir. For a discussion of the lethal effects that silt deposition has on mussels, see *infra* Part III.D.1.

⁴³ For discussion of the mechanisms by which reservoirs are unsuitable habitat for mussel species, see, for example, Fuller, *supra* note 32, at 247–51 (documenting the adverse effects upon mussels resulting from dams and silts); Bogan, *supra* note 21, at 604 (“Damming dramatically alters the environment of what was formerly a free-flowing river by altering the fish fauna, substrate composition, benthic community, water chemistry, amount of dissolved

reservoir construction has resulted in the expansion of the range of a few species of freshwater mollusks that require lake habitats,⁴⁴ the majority of mussel species which require fast-flowing rivers or streams have been decimated by impoundment construction,⁴⁵ resulting in the extinction of a number of species in the Southeast, an area where dam construction was particularly intensive and widespread. Some of the best freshwater mussel habitat in the world, for instance, at Muscle Shoals in northern Alabama, was mostly destroyed by the construction of a dam.⁴⁶ The Tennessee River, which from the 1920s to the 1960s was dammed for approximately 360 of its first 531 miles, by 1969 had lost fifty-six of the one hundred species found in pre-impoundment surveys.⁴⁷

Channelization can have similar impacts on mussel fauna. The change in flow regime in many channelized rivers and canals can result in slower flow regimes and increased silt deposition, with similar harmful effects on mussel fauna as those created by dams. Channelization can also have a harmful impact on mussel species through the opposite result—the direct elimination of substrate through increased flow rates and stream velocity.⁴⁸

oxygen, and water temperature.”); Box & Mossa, *supra* note 38, at 100–01 (discussing the increase in sedimentation as a result of impoundments); Willard N. Harman, *The Effects of Reservoir Construction and Canalization on the Mollusks of the Upper Delaware Watershed*, 1974 BULL. AM. MALACOLOGICAL UNION 12, 12 (1974); Scott Palmer, *Some Extinct Molluscs of the U.S.A.*, 13 ATALA 1, 3 (1985) (discussing the ecological effects of dam construction); Stansbery, *supra* note 38, at 10 (discussing the decreased current that results from impoundments); Caryn C. Vaughn & Christopher M. Taylor, *Impoundments and the Decline of Freshwater Mussels: A Case Study of an Extinction Gradient*, 13 CONSERVATION BIOLOGY 912, 913 (1999) (discussing harmful effects on freshwater mussels both above and below river impoundments).

⁴⁴ See Isom, *supra* note 31, at 416 (noting presence of Cumberlandian mussels in an area previously unpopulated by that species prior to the impoundment of Pickwick reservoir); Fuller, *supra* note 32, at 250; Box & Mossa, *supra* note 38, at 100.

⁴⁵ See G. Thomas Watters, *Small Dams as Barriers to Freshwater Mussels* (Bivalvia, Unionoida) and *Their Hosts*, 75 BIOLOGICAL CONSERVATION 79, 79 (1996) (“There is ample evidence that most species cannot live in impoundments.”). For discussion of the extirpation of mussel populations due to dam impoundments, see, for example, Charles M. Cooper & V. Wayne Johnson, *Bivalve Mollusca of the Yalobusha River, Mississippi*, 94 NAUTILUS 22, 24 (1980) (stating that extensive channelization and damming of river section had eliminated 13 of the previous 15 species found before impoundment); Mark E. Gordon, *Mollusca of the White River, Arkansas and Missouri*, 25 SOUTHWESTERN NATURALIST 347, 347 (1982) (stating that 36 of the previously recorded 100 species from the White River drainage have been eliminated, in part because of dam construction); Palmer, *supra* note 43, at 1–3 (indicating that dam construction has led to the extinction of a number of mussel species from the Coosa River in Alabama and Georgia); Stansbery, *supra* note 38, at 11 (noting that dams have contributed significantly to the elimination of mussel populations); Box & Mossa, *supra* note 38, at 100; Isom, *supra* note 31, at 397; see also Watters, *supra*, at 80–81 (describing the limitation in range of two mussel species by small dams).

⁴⁶ See Isom, *supra* note 31, at 415–17 (noting this was “one of the finest mussel habitats known,” harboring 69 species prior to impoundment, and now harboring only 44 species).

⁴⁷ *Id.* at 397.

⁴⁸ Box & Mossa, *supra* note 38, at 103; Harman, *supra* note 43, at 12; Fuller, *supra* note 32, at 246–47.

D. Indirect Human Impacts Through Habitat Alteration

Besides human activities that directly eliminate mussel habitat, there is a wide range of human activities that indirectly affect the quality of existing mussel habitat, making it less suitable through increased siltation, pollution, and changes in temperature. The remaining mussel habitat therefore becomes lower quality, and mussel survival and reproduction in those populations that remain after habitat destruction is reduced.

1. Siltation Due to Runoff and Erosion

Freshwater mussels are apparently extremely sensitive to increased sediment and silt transport and deposition in their water habitat.⁴⁹ As discussed above, mussels are filter feeders and, therefore, increased siltation or sedimentation in the water column may clog the digestion system of mussels, effectively starving the mussels to death either directly through clogging, or indirectly through forcing the mussels to close their valves and stop feeding in order to prevent clogging.⁵⁰ Silt and sediment can also cover mussels and suffocate them, or can create a soft, mucky substrate that the mussels sink into and suffocate.⁵¹ Silt and sediment appear to have significantly greater effects on juvenile mussels, which may be especially susceptible to being buried by silt due to their small size and vulnerability.

Sedimentation and silt effects on streams and rivers can come from a wide variety of sources. Dams and channelization projects usually increase sediment deposition rates to the detriment of much of the mussel fauna in the impoundment or channel.⁵² Logging, agriculture, ranching, mining, urban development, and construction activities in general have all been implicated in increased sedimentation rates.⁵³ Many of the biologists interviewed for this Comment characterized sedimentation as one of the primary threats to freshwater mussels.⁵⁴

⁴⁹ See Leslie E. Holland-Bartels, *Physical Factors and Their Influence on the Mussel Fauna of a Main Channel Border Habitat of the Upper Mississippi River*, 9 J. N. AM. BENTHOLOGICAL SOC'Y 327, 332-34 (1990) (finding that increase in small sediment transport was significantly negatively correlated with mussel distribution).

⁵⁰ M.M. Ellis, *Erosion Silt as a Factor in Aquatic Environments*, 17 ECOLOGY 29, 39-40 (1936) (describing experiments that examined the smothering effect of silt on 18 species of freshwater mussels); David W. Aldridge et al., *The Effects of Intermittent Exposure to Suspended Solids and Turbulence on Three Species of Freshwater Mussels*, 45 ENVTL. POLLUTION 17, 18 (1987); Bogan, *supra* note 21, at 603; Stansbery, *supra* note 38, at 10; Box & Mossa, *supra* note 38, at 101; Fuller, *supra* note 32, at 250-51.

⁵¹ Ellis, *supra* note 50, at 39-40.

⁵² See discussion *supra* Part III.C.2.

⁵³ Box & Mossa, *supra* note 38, at 102-03; Stansbery, *supra* note 38, at 10; Bogan, *supra* note 21, at 603-04.

⁵⁴ See Telephone Interview with G. Thomas Watters, Curator of Mollusks, Museum of Biological Diversity, Dep't of Evolution Ecology and Organismal Biology, Ohio State Univ. (Apr. 6, 2001) [hereinafter Watters Interview]; Bogan Interview, *supra* note 33; Telephone Interview with Kevin Cummings, Research Scientist, Illinois Natural History Survey (Apr. 6, 2001) [hereinafter Cummings Interview]; Telephone Interview with Biologist, U.S. Fish and Wildlife Serv. (Apr. 11, 2001) [hereinafter April 11 Biologist Interview]; Telephone Interview with Jayne

2. Sewage Effluent: Eutrophication and Chlorination

Sewage treatment plants often emit large volumes of water into rivers, streams, and lakes, and the effluent can carry substantial levels of organic pollutants such as nitrogen and phosphorus, as well as chlorine used by the sewage treatment plant to kill fecal coliform bacteria in the sewage. Eutrophication of waterways (the increased input of nutrients such as phosphorus) has been shown to be detrimental to certain kinds of freshwater mussels, for as yet undetermined reasons.⁵⁵ The inputs of nitrogen and phosphorus from sewage treatment plants may therefore be an important limiting factor for some mussel species.⁵⁶

More importantly, most sewage treatment plants treat their outgoing effluent with chlorine in order to eliminate fecal coliform bacteria. Chlorine can be extremely harmful to mussel populations downriver from the sewage outfalls—chlorine is a toxic substance to all life forms, and the limited mobility of mussels means that they are often unable to escape the impact of chlorinated sewage before mortality ensues. Sewage outfalls have been found to strongly correlate with the absence of mussels, particularly in small and medium-sized streams and rivers.⁵⁷

3. Nonpoint Runoff: Urban and Agricultural

Urban and agricultural runoff can often contribute substantial inputs of nutrients, leading to eutrophication, which may be harmful to numerous

Brim Box, Fisheries Biologist, U.S. Geologic Survey, Biological Resources Division (Apr. 12, 2001) [hereinafter Box Interview]; Telephone Interview with Leroy Koch, Biologist, Southwest Virginia Field Office, U.S. Fish and Wildlife Serv. (Apr. 13, 2001) [hereinafter Koch Interview]; Telephone Interview with Patricia Morrison, Fish and Wildlife Biologist, U.S. Fish and Wildlife Serv. (Apr. 16, 2001) [hereinafter Morrison Interview]. *But see* Hartfield Interview, *supra* note 33 (arguing that sedimentation is a decreased problem today compared with the past because of improved agricultural practices).

⁵⁵ See G. Bauer, *Age Structure, Age Specific Mortality Rates and Population Trend of the Freshwater Pearl Mussel (Margaritifera margaritifera) in North Bavaria*, 98 ARCHIV FÜR HYDROBIOLOGIE 523, 530–31 (1983) (predicting that the population of mussels in North Bavaria will decline over the next decades as water quality deteriorates); David L. Strayer, *Macrohabitats of Freshwater Mussels (Bivalvia: Unionacea) in Streams of the Northern Atlantic Slope*, 12 J. N. AM. BENTHOLOGICAL SOC'Y 236, 242–43 (1993) [hereinafter Strayer, *Macrohabitats of Freshwater Mussels*] (study predicting “the broad scale . . . distributions of freshwater mussels from readily available macrohabitat descriptors”); *see also* Schmidt et al., *supra* note 38, at 57 (implicating eutrophication from sewage treatment outfalls as a possible cause for decline in mussel fauna in a watershed); Fuller, *supra* note 32, at 252 (noting that low levels of eutrophication may help mussels by increasing food availability, but high levels of eutrophication appear to harm mussels because of decreased dissolved oxygen, increased carbon dioxide, and lowered pH).

⁵⁶ See Telephone Interview with Biologist, U.S. Fish and Wildlife Serv. (Apr. 27, 2001) [hereinafter April 27 Biologist Interview] (speculating that high ammonia and other pollutant levels from agriculture and sewage outfalls may be causing harm to juvenile mussels, which may be particularly vulnerable to contaminants).

⁵⁷ Stephanie E. Goudreau et al., *Effects of Wastewater Treatment Plant Effluents on Freshwater Mollusks in the Upper Clinch River, Virginia, USA*, 252 HYDROBIOLOGIA 211, 212 (1993).

mussel species as discussed above.⁵⁸ Agricultural runoff may contain pesticides, which are thought to have resulted in mussel mortality or die-offs.⁵⁹ Urbanization has been observed to correlate with sharp declines in mussel populations in affected streams.⁶⁰

Urbanization and suburbanization may have impacts on mussel fauna by changing the hydrologic cycle of affected watersheds. Increases in impermeable surfaces in watersheds can result in less water percolating into the soil and more water running off directly into waterways. The result can be higher peak flows during storm events (including flooding) and lower flows during periods of droughts (because reduced infiltration of water into the groundwater means the water table may be lowered). These changes in the hydrologic cycle may negatively affect mussels by increasing the size of flood events (which may wash away mussels to less suitable habitat or harm them through scouring by sediment) and by increasing the risk of desiccation during low flow events.⁶¹ Desiccation of mussels has also been found to be a problem in rivers directly below dams, where reduced releases of water from the dams can leave mussels above the water level.⁶²

4. Acid Mine Drainage

As noted above, one of the centers for mussel diversity is the Appalachian Mountain region of West Virginia, western Virginia, Kentucky, Tennessee, and western North Carolina. This area has also long been a center for coal production in the United States, as well as other mining activities. Mining often results in the creation of large amounts of acid mine waste—runoff from mining activities that is highly acidic compared to natural pH levels.⁶³ Low pH levels have been shown to be toxic to mussels

⁵⁸ Schmidt et al., *supra* note 38, at 57.

⁵⁹ See Marian E. Havlik & Leif L. Marking, *Effects of Contaminants on Naiad Mollusks (Unionidae): A Review*, in U.S. FISH AND WILDLIFE SERV. RESOURCE PUBLICATION 164, at 13 (1987); U.S. FISH AND WILDLIFE SERV., REVISED TAR SPINYMUSSSEL RECOVERY PLAN 2-4 (1992) [hereinafter TAR SPINYMUSSSEL RECOVERY PLAN] (listing agricultural runoff as a threat to tar spiny mussel habitat). A number of biologists I interviewed believed that pesticide and herbicide runoff from agriculture has been a major cause of freshwater mussel decline, particularly as a result of chemicals that are bound to sediment eroded from agricultural fields. Telephone Interview with Biologist, U.S. Fish and Wildlife Serv. (Apr. 19, 2001) [hereinafter April 19 Biologist Interview]; Telephone Interview with David H. Stansbery, Emeritus Professor in Ecology and Evolutionary Biology, Ohio State Univ. (Apr. 6, 2001).

⁶⁰ See Dave Strayer, *The Freshwater Mussels (Bivalvia: Unionidae) of the Clinton River, Michigan, with Comments on Man's Impact on the Fauna, 1870-1978*, 94 NAUTILUS 142, 148 (1980) ("All stream stretches subjected to urban pollution in the Clinton system have lost their mussel faunas, whereas most of the streams free of urban pollution still contain dense and diverse mussel beds, in spite of disturbances from other sources there.").

⁶¹ See Strayer, *Macrohabitats of Freshwater Mussels*, *supra* note 55, at 241-42 (discussing the effect of stream stability on mussel species).

⁶² Vaughn & Taylor, *supra* note 43, at 916-17; see also April 11 Biologist Interview, *supra* note 54 (noting the difficulty in protecting habitat in areas below dams).

⁶³ See John Cairns, Jr., *Protozoans (Protozoa)*, in POLLUTION ECOLOGY OF FRESHWATER INVERTEBRATES 1, 15 (C.W. Hart & Samuel L.H. Fuller eds., 1974) (discussing the release of heavy metals into aquatic ecosystems through mining and other industrial activities); J.D.

(as they are to most living organisms),⁶⁴ and acid mine drainage has been implicated in the range reduction and die-off of numerous mussel species and populations.⁶⁵

5. Industrial and Other Toxic Pollution

Mussels are known to be excellent monitors of heavy metal pollution because of their ability to filter water and to accumulate metals.⁶⁶ There is evidence that freshwater mussels are harmed or killed by high levels of a range of metallic pollutants, although some pollutants appear to have less of a negative impact.⁶⁷

6. Temperature Alterations

Breeding of freshwater mussels is often controlled in part by water temperature. At low temperatures, adult mussels may survive, but they will not release sperm or produce egg masses.⁶⁸ Mussels also will grow and develop at much slower rates at lower water temperatures and can be killed by extreme water temperatures, even when above freezing.⁶⁹

Human activities, in particular dam construction and operation, have been found to significantly alter the temperature regimes of rivers to the detriment of mussel populations.⁷⁰ Dams can vary in the manner in which they release water from the reservoir to the downstream river. Many dams are "deep release" dams that release water from near the bottom of the dam and the deeper depths of the reservoir. This deeper water is usually significantly colder than upper level water and much colder than the original water temperature for the undammed river. As a result, preexisting mussel populations downstream from "deep release" dams are faced with

Huebner & K.S. Pynnonen, *Viability of Flochidia of Two Species of Anodonta Exposed to Low pH and Selected Metals*, 70 CANADIAN J. ZOOLOGY 2348, 2354 (1992) (discussing the effects of elevated concentrations of metals within lake habitat as a result of anthropogenic sources).

⁶⁴ Havlik & Marking, *supra* note 59, at 11; T.P. Makela & A.O.J. Oikari, *The Effects of Low Water pH on the Ionic Balance in Freshwater Mussel Anodonta anatina L.*, 29 ANNALES ZOOLOGICA FENNICI 169, 172-74 (1992); Huebner & Pynnonen, *supra* note 63, at 2353 (showing that low pH reduces the viability of juvenile mussels); George M. Simmons, Jr. & James R. Reed, Jr., *Mussels as Indicators of Biological Recovery Zone*, 45 J. WATER POLLUTION CONTROL FED'N 2480, 2490 (1973) (indicating that mussels were unable to recolonize a stream that had been heavily affected by acid mine drainage).

⁶⁵ Fuller, *supra* note 32, at 252 ("I have seen streams where practically all macroinvertebrate life had been exterminated by acid mine wastes in the Slippery Rock Creek drainage of Western Pennsylvania . . ."); Bogan, *supra* note 21, at 604 (noting that mussel fauna have been eliminated from many streams by acid mine drainage).

⁶⁶ Fuller, *supra* note 32, at 243-46; Havlik & Marking, *supra* note 59, at 3; Marc J. Imlay, *Use of Shells of Freshwater Mussels in Monitoring Heavy Metals and Environmental Stresses: A Review*, 15 MALACOLOGICAL REV. 1, 1 (1982).

⁶⁷ Havlik & Marking, *supra* note 59, at 3-12; Fuller, *supra* note 32, at 243-46; Huebner & Pynnonen, *supra* note 63, at 2348.

⁶⁸ Fuller, *supra* note 32, at 240-41; Vaughn & Taylor, *supra* note 43, at 917.

⁶⁹ Harman, *supra* note 43, at 12; Fuller, *supra* note 32, at 241.

⁷⁰ Harman, *supra* note 43, at 12.

significantly colder temperatures in their habitat. Researchers have reported significant declines (and even extirpations) in mussel populations downstream from such “deep release” dams, with the hypothesis being that the cold temperature of released water is a major factor in the decline.⁷¹

E. Exotic Species

As noted above, an “exotic species” is a species that has been introduced by humans into an ecosystem or other geographic area where the species did not previously occur. If the introduction is successful, the exotic species will then reproduce and expand its range, occasionally resulting in enormous population increases and dramatic range expansions. The new exotic species can have significant negative effects on the native, pre-existing species through predation, competition, and the transmission of diseases and parasites. Two exotic freshwater mussel species introduced to the United States within the past one hundred years have had (and will continue to have) potentially significant negative impacts on native freshwater mussel species in North America, primarily through competition: the Asian clam, and the zebra mussel.

I. Asian Clam

The Asian clam (*Corbicula fluminea*) was introduced into the Pacific Northwest in the 1930s and has since spread throughout North America.⁷² It is a freshwater mollusk, like the native freshwater mussels of the United States, but it appears to be far more tolerant of highly disturbed river and stream conditions than the native mussels.⁷³ *Corbicula*, in the course of its rapid expansion, has sometimes achieved extremely high densities, and has caused problems through the clogging and fouling of water-intake pipes of power plants because of its dense, rapid growth.⁷⁴ The rapid expansion of *Corbicula* and its impacts on river ecosystems has been of concern to scientists, who fear that the species might be displacing native mollusks, either through competition for space, or through competition for food. *Corbicula*, particularly at high densities, can be a prodigious filter feeder, removing substantial amounts of food from the water column.⁷⁵ Researchers have feared that *Corbicula* might be starving the native freshwater mussel species to death by outcompeting them for food resources in the water

⁷¹ Fuller, *supra* note 32, at 249; Harman, *supra* note 43, at 12; Gordon, *supra* note 45, at 351; Vaughn & Taylor, *supra* note 43, at 917.

⁷² U.S. Geological Survey, *Nonindigenous Aquatic Species: Corbicula fluminea* Muller 17.74, at http://nas.er.usgs.gov/mollusks/docs/co_flumi.html (last visited on Oct. 29, 2001).

⁷³ Kraemer, *supra* note 38, at 1085–86; Robert F. McMahon, *Ecology of an Invasive Pest Bivalve, Corbicula*, 6 MOLLUSCA 505, 516–17 (1983).

⁷⁴ Alton C. Boozer & P.E. Mirkes, *Observations on the Fingernail Clam, Musculium partumeium (Pisidiidae) and its Association with the Introduced Asian Clam, Corbicula fluminea*, 93 NAUTILUS 73, 73–74 (1979); McMahon, *supra* note 73, at 512–17.

⁷⁵ DILLON, *supra* note 10, at 212.

column.⁷⁶ There is some evidence that increases in *Corbicula* populations in a stream or river have been correlated with the collapse of native freshwater species,⁷⁷ but the evidence has been contradictory and unclear in many other situations.⁷⁸ Most biologists currently believe that Asian clams are not a significant threat to native freshwater mussels, and that any correlation between declines in freshwater mussel populations and increases in Asian clam populations is due instead to habitat deterioration that favors the Asian clams over native mussels.⁷⁹

2. Zebra Mussel

Unlike the evidence regarding Asian clams, the evidence of the negative impacts of zebra mussels on native freshwater species has been clear and overwhelming.⁸⁰ Zebra mussels, originally from Europe, were first introduced to the Great Lakes near Detroit in the late 1980s, probably through the ballast water of a ship that had arrived from Europe.⁸¹ The mussels immediately began spreading throughout the Great Lakes,⁸² with enormous population expansions. Zebra mussel populations have been recorded at up to 750,000 individuals per square meter⁸³ and have fundamentally changed the ecology of Lake Erie and other Great Lakes through their filtration and removal of enormous amounts of suspended

⁷⁶ CAROLINA HEELSPLITTER RECOVERY PLAN, *supra* note 12, at 4–5; U.S. FISH AND WILDLIFE SERV., JAMES SPINYMUSSSEL (*PLUEROBEMA COLLINA*) RECOVERY PLAN 9–10 (1990) [hereinafter JAMES SPINYMUSSSEL RECOVERY PLAN]; TAR SPINYMUSSSEL RECOVERY PLAN, *supra* note 59, at 13; David L. Strayer, *Effects of Alien Species on Freshwater Mollusks in North America*, 18 J. N. AM. BENTHOLOGICAL SOC'Y 74, 82–83 (1999) [hereinafter Strayer, *Effects of Alien Species*]. There are also fears that dense *Corbicula* populations might filter and feed upon the glochidia of native mussel species. *Id.*

⁷⁷ J.A. Gardner, Jr. et al., *The Invasion of the Asiatic Clam (Corbicula manilensis philippi) in the Altamaha River, Georgia*, 90 NAUTILUS 117, 122 (1976); Strayer, *Effects of Alien Species*, *supra* note 76, at 82–83; DILLON, *supra* note 10, at 210–12; JAMES SPINYMUSSSEL RECOVERY PLAN, *supra* note 76, at 9–10. One researcher studying mollusk colonization of a power plant water-intake pipe found that *Corbicula* completely excluded a native freshwater mollusk species from certain areas of the intake pipe. Boozer & Mirkes, *supra* note 74, at 74.

⁷⁸ Kraemer, *supra* note 38, at 1092; Strayer, *Effects of Alien Species*, *supra* note 76, at 81 (“Unfortunately, the evidence for *Corbicula*'s impacts is weak, so its role in affecting native bivalves still is unresolved.”).

⁷⁹ See Bogan Interview, *supra* note 33 (stating that it is unclear whether Asian clams are having a negative competitive impact on native freshwater mussels); Cummings Interview, *supra* note 54 (stating that the impact of Asian clams is “almost zero”); Hartfield Interview, *supra* note 33 (“[The Service] can't point to a single instance of Asian clams moving Unionid mussels out.”); Koch Interview, *supra* note 54 (“[F]reshwater mussels can make it alongside *Corbicula* assuming river conditions stabilize or improve.”).

⁸⁰ Anthony Ricciardi et al., *Impending Extinctions of North American Freshwater Mussels (Unionida) Following the Zebra Mussel (Dreissena polymorpha) Invasion*, 67 J. ANIMAL ECOLOGY 613 (1998) [hereinafter Ricciardi et al., *Impending Extinctions*].

⁸¹ Paul D.N. Hebert et al., *Demography and Ecological Impacts of the Invading Mollusk Dreissena polymorpha*, 69 CANADIAN J. ZOOLOGY 405, 405 (1991).

⁸² *Id.*

⁸³ Don W. Schloesser et al., *Zebra Mussel Infestation of Unionid Bivalves (Unionida) in North America*, 36 AM. ZOOLOGIST 300, 300 (1996).

particles.⁸⁴ Researchers have feared that, as with the Asian clam, the spread of the zebra mussel could result in population reductions of native freshwater mussels by outcompeting the mussels for filtration of food resources.⁸⁵

However, there is a far more direct, immediate, and serious threat to freshwater mussels from zebra mussels: native freshwater mussels are apparently a favorite substrate for zebra mussel juveniles to attach and grow upon.⁸⁶ As a result, an individual native mussel, in areas with heavy zebra mussel infestation, can be covered with hundreds and hundreds of zebra mussels (sometimes up to 10,000!),⁸⁷ which prevent the native mussel from opening or closing its valves or its main "mouth" and from moving or burying in the substrate to avoid hostile conditions.⁸⁸ The results have been catastrophic for native freshwater mussels, and once large native mussel populations have been eliminated from the Great Lakes and the St. Lawrence River.⁸⁹ While the eventual distribution of zebra mussels throughout the United States is unknown,⁹⁰ zebra mussels have expanded

⁸⁴ G.L. Mackie, *Biology of the Exotic Zebra Mussel, Dreissena polymorpha, in Relation to Native Bivalves and its Potential Impact in Lake St. Claire*, 219 *HYDROBIOLOGIA* 251, 266 (1991); Strayer, *Effects of Alien Species*, *supra* note 76, at 77-78; see also David L. Strayer et al., *Transformation of Freshwater Ecosystems by Bivalves: A Case Study of Zebra Mussels in the Hudson River*, 49 *BIOSCIENCE* 19, 21 (1999) (noting the potential impacts of the zebra mussel on the Hudson River due to its enormous filter feeding capacity).

⁸⁵ See sources cited *supra* note 76, particularly Strayer, *Effects of alien species*, at 78-79.

⁸⁶ A. Ricciardi et al., *Impact of the Dreissena Invasion on Native Unionid Bivalves in the Upper St. Lawrence River*, 53 *CANADIAN J. FISHERIES & AQUATIC SCI.* 1434, 1437 (1996). However, this preference may simply be because, in many of the Great Lakes areas, unionids are the only hard substrate zebra mussels can colonize, and given other hard substrates, unionids are no more likely to be colonized than other substrates. Susan A. Toczylowski & R. Douglas Hunter, *Do Zebra Mussels Preferentially Settle on Unionids and/or Adult Conspecifics?*, in *ZEBRA MUSSELS AND AQUATIC NUISANCE SPECIES* 125, 136-38 (Frank M. D'Itri ed., 1997).

⁸⁷ Schloesser et al., *supra* note 83, at 300; Hebert et al., *supra* note 81, at 406.

⁸⁸ Strayer, *Effects of Alien Species*, *supra* note 76, at 77-78; Ricciardi et al., *supra* note 86, at 1437-42; Wendell R. Haag et al., *Reduced Survival and Fitness in Native Bivalves in Response to Fouling by the Introduced Zebra Mussel (Dreissena polymorpha) in Western Lake Erie*, 50 *CANADIAN J. FISHERIES & AQUATIC SCI.* 13, 16-18 (1993); S.M. Baker & D.J. Hornbach, *Acute Physiological Effects of Zebra Mussel (Dreissena polymorpha) Infestation on Two Unionid Mussels, Actinonaias ligamentina and Amblema plicata*, 54 *CANADIAN J. FISHERIES & AQUATIC SCI.* 512, 514-18 (1997); Schloesser et al., *supra* note 83, at 305-08.

⁸⁹ Ricciardi et al., *Impending Extinctions*, *supra* note 80, at 615-16; Mackie, *supra* note 84, at 251; P.L. Gillis & G.L. Mackie, *Impact of the Zebra Mussel, Dreissena polymorpha, on Populations of Unionidae (Bivalvia) in Lake St. Clair*, 72 *CANADIAN J. ZOOLOGY* 1260, 1265-68 (1994); R. Douglas Hunter & John F. Bailey, *Dreissena polymorpha (Zebra Mussel): Colonization of Soft Substrata and Some Effects on Unionid Bivalves*, 106 *NAUTILUS* 60, 65-66 (1992); Don W. Schloesser & Thomas F. Nalepa, *Dramatic Decline of Unionid Bivalves in Offshore Waters of Western Lake Erie After Infestation by the Zebra Mussel, Dreissena polymorpha*, 51 *CANADIAN J. FISHERIES & AQUATIC SCI.* 2234, 2238-41 (1994); Thomas F. Nalepa, *Decline of Native Unionid Bivalves in Lake St. Clair After Infestation by the Zebra Mussel, Dreissena polymorpha*, 51 *CANADIAN J. FISHERIES & AQUATIC SCI.* 2227, 2230-32 (1994); Ricciardi et al., *supra* note 86, at 1439-42.

⁹⁰ See David L. Strayer, *Projected Distribution of the Zebra Mussel, Dreissena polymorpha, in North America*, 48 *CANADIAN J. FISHERIES & AQUATIC SCI.* 1389, 1394-95 (1991) [hereinafter Strayer, *Projected Distribution*] (providing an estimate of range of zebra mussels in the United States based on its European distribution); Patrick Baker et al., *Potential Range of the Zebra*

into the Mississippi, Ohio, and Tennessee River watersheds, the center of native freshwater mussel diversity,⁹¹ the sites of some of the largest populations, and the refugia for most of the endangered and threatened freshwater mussel species in the United States. Zebra mussels have also expanded into the Hudson River.⁹²

F. Host Species

As noted previously, freshwater mussel species depend on host fish species for the development and dispersal of their young to new habitats. The impacts listed above that have eliminated or degraded mussel habitat also have significant impacts on host fish species. Thus many hosts have seen significant range and population reductions. Many host fish species, like the mussel species, require fast-running rivers and streams and will not survive (usually because of the lack of breeding areas) in reservoirs.⁹³ Even

Mussel, Dreissena Polymorpha in and Near Virginia, 51 VA. SEA GRANT MARINE RESOURCE ADVISORY 3, 3-11 (1993) (providing an estimate of zebra mussel invasion ranges in the mid-Atlantic). There are indications that zebra mussels might be unable to invade rivers or streams with particularly low levels of dissolved calcium, small rivers or streams, and fast-flowing rivers and streams that do not have upstream reservoirs or lakes that can serve as a source for colonization of zebra mussels downstream. Strayer, *Effects of Alien Species*, supra note 76, at 76-77; Strayer, *Projected Distribution*, supra, at 1394.

⁹¹ James B. Sickel & Denise A. Leek, *Observations on Zebra Mussel Colonization in the Lower Ohio and Tennessee Rivers*, PROCEEDINGS OF THE FOURTH INTERNATIONAL ZEBRA MUSSEL CONFERENCE, MADISON, WISCONSIN, Mar. 1994, at 448-49; Schloesser et al., supra note 83, at 304-05; Ricciardi et al., *Impending Extinctions*, supra note 80, at 615-18; Andrew C. Miller & Barry S. Payne, *Density and Size Demography of Newly Established Populations of Dreissena polymorpha in the U.S. Inland Waterway System*, in ZEBRA MUSSELS AND AQUATIC NUISANCE SPECIES, supra note 86, at 100; James A. Stice, *Zebra Mussel Colonization in the Ohio River Region and Its Effects*, in ZEBRA MUSSELS AND AQUATIC NUISANCE SPECIES, supra note 86, at 155. Recent population trends show that zebra mussels have continued to grow exponentially in the Upper Mississippi, with some beds of zebra mussels now three feet deep. However, zebra mussel populations, after massive increases, appear to have experienced severe reductions in the Illinois River and in the Ohio River. Telephone Interview with Pam Thiel, Project Leader, LaCrosse Fishery Resource Office, U.S. Fish and Wildlife Serv. (Apr. 12, 2001) [hereinafter Thiel Interview]; Tolin Interview, supra note 33.

⁹² David L. Strayer & Lane C. Smith, *Relationships Between Zebra Mussels (Dreissena polymorpha) and Unionid Clams During the Early Stages of the Zebra Mussel Invasion of the Hudson River*, 36 FRESHWATER BIOLOGY 771, 772 (1996); David L. Strayer et al., *Effects of the Zebra Mussel (Dreissena polymorpha) Invasion on the Macrobenthos of the Freshwater Tidal Hudson River*, 76 CANADIAN J. ZOOLOGY 419, 420 (1998). Another alien species has already been introduced to the United States that might have a significant negative impact on native mussels, according to biologists. The black carp has been introduced onto aquaculture farms in the South, and biologists believe this species has the potential to escape and cause serious harm as a predator to native mussel species. Thiel Interview, supra note 91; Telephone Interview with David Strayer, Scientist, Institute of Ecosystem Studies (Feb. 16, 2001) [hereinafter Strayer Interview].

⁹³ See, e.g., Fuller, supra note 32, at 247-48; Bogan, supra note 21, at 604; Vaughn & Taylor, supra note 43, at 917. There is also evidence that other forms of habitat degradation will eliminate host fish species, or will interfere with the mussel/fish interaction. See Box & Mossa, supra note 38, at 101-02 (noting that many mussels use brightly colored lures to attract fish, but sedimentation may reduce the effectiveness of these lures for visually-feeding fish such as bass).

if a host fish species can survive in the changed habitat, or if the dam is small enough not to create a significant reservoir, the dam itself can block movement of the fish upstream or downstream. If the host fish species is later eliminated from the portion of the river isolated by the dam, that fish species will be unable to recolonize the isolated river stretch. As a result, the mussel species will be deprived of its host fish species, will fail to reproduce, and eventually will disappear. Of course, the more fish species that are hosts to a particular mussel species, the less the risk that the mussel species will disappear from a particular area due to the disappearance of a single fish species—however, many mussel species appear to have quite limited numbers of host fish species,⁹⁴ and many human impacts on rivers (e.g., dams) affect all (or almost all) fish species in the same way. The disappearance of host fish species has therefore been implicated as a significant cause of the decline of freshwater mussels in the United States.⁹⁵

G. The Deleterious Effects of Small Population Size and Fragmentation of Both Population and Habitat

The result of the habitat destruction and deterioration has been to eliminate many mussel populations throughout North America. The elimination of populations and suitable habitat has resulted in the fragmentation of the remaining populations and suitable habitat, in addition to severely reducing the overall number of mussels present in general, and the number present in any one population.

The elimination of many populations and the severe reduction in size of existing populations obviously makes the recovery of mussel populations more difficult. Because mussels have relatively low reproductive rates, the rate of growth of the mussel populations (which depends in part on the current population size), even if all factors are favorable, will be relatively low in absolute terms for a substantial period of time. In addition, the small population size of many mussel species means that much of the genetic variation within the species has disappeared. Such “genetic bottlenecks” can make species very vulnerable to birth defects (due to inbreeding) and disease (due to reduced genetic variation in the factors that might allow for resistance to those diseases), and also leave a species with relatively little genetic variation to allow for adaptation to the changed environmental circumstances bound to arise in the future.⁹⁶

⁹⁴ See Richard J. Neves, *A State-of-the-Union Address*, in CONSERVATION AND MANAGEMENT OF FRESHWATER MUSSELS, *supra* note 26, at 1, 4 (listing the number of fish species known to be hosts for mussel genera, noting the lack of knowledge about fish hosts by biologists, and noting that the fewer the host species for a particular mussel species the greater the vulnerability of that species to reproductive failure).

⁹⁵ See Watters, *supra* note 45, at 79 (finding that two rare mussel species distributions are determined in large part by the presence of small dams on rivers and streams, indicating that barriers to fish movement are the cause of mussel disappearances); Vaughn & Taylor, *supra* note 43, at 917.

⁹⁶ GARY K. MEFFE & C. RONALD CARROLL, PRINCIPLES OF CONSERVATION BIOLOGY 153–58 (1994).

Furthermore, the reduced numbers of mussel populations and the reduced number of individuals in each population make the survival and recovery of mussel species more difficult because of the nature of their reproductive cycle. Because male mussels release their sperm into the water column and rely on the water current to transport the sperm to a fertile female, the spatial aggregation of large numbers of mussels in healthy population beds is essential to the reproductive success of mussels.⁹⁷ Simply put, if the mussels are spread out, the sperm of the males will be wasted throughout the water column; if mussels are healthy and densely packed, sperm is much more likely to encounter a receptive female. This density factor makes the decimation of many healthy mussel populations all the more troubling.

Finally, the fragmentation of populations and habitats makes mussel species further vulnerable to extinction. For many species, biologists believe that movement between patches of suitable habitat is essential to the long-term survival of that species.⁹⁸ Under this "metapopulation" model,⁹⁹ there are a number of "islands" of suitable habitat surrounded by unsuitable "matrix" areas. Individuals of the species can survive and reproduce on the island, but can only disperse through the matrix with varying degrees of success.¹⁰⁰ Due to random environmental disturbances¹⁰¹ (e.g., fires temporarily eliminating a particular island of habitat, disease eliminating a population in a particular island, a harsh winter that kills individuals in some islands but not others) and random variations in population sizes¹⁰² (e.g., small populations on small islands may, through chance, eventually disappear), some islands will become depopulated. However, the species does not eventually become extinct as a result—movement of individuals from still-surviving populations on other islands of habitat allows for the recolonization of the depopulated islands.¹⁰³

Without this dispersal, the risk of extinction of the species as a whole increases substantially. One by one, through random events, populations

⁹⁷ John A. Downing et al., *Spatial Aggregation, Body Size, and Reproductive Success in the Freshwater Mussel* *Elliptio complanata*, 12 J. N. AM. BENTHOLOGICAL SOC'Y 148, 148 (1993).

⁹⁸ See Ilkka Hanski & Daniel Simberloff, *The Metapopulation Approach, Its History, Conceptual Domain, and Application to Conservation*, in *METAPOPULATION BIOLOGY: ECOLOGY, GENETICS, AND EVOLUTION* 5, 24 (I. Hanski & M.E. Gilpin eds., 1997) (arguing that scattered populations of a species, individuals of which are not able to disperse between the scattered populations, can be "an assemblage of populations all slowly declining to extinction"); David Tilman et al., *Habitat Destruction and the Extinction Debt*, 371 NATURE 65, 65-66 (1994) (providing a mathematical model that predicts that species having scattered populations in patchy habitat, surrounded by unsuitable habitat, can become extinct over time as patches are destroyed).

⁹⁹ Hanski & Simberloff, *supra* note 98, at 12-13 (detailing various metapopulation models).

¹⁰⁰ John A. Wiens, *Metapopulation Dynamics: From Concepts and Observations to Predictive Models*, in *METAPOPULATION BIOLOGY: ECOLOGY, GENETICS, AND EVOLUTION*, *supra* note 98, at 43, 44-45.

¹⁰¹ See, e.g., Patrick Foley, *Extinction Models for Local Populations*, in *METAPOPULATION BIOLOGY: ECOLOGY, GENETICS, AND EVOLUTION*, *supra* note 98, at 215, 218 (explaining environmental stochasticity).

¹⁰² *Id.* at 231.

¹⁰³ *METAPOPULATION BIOLOGY: ECOLOGY, GENETICS, AND EVOLUTION*, *supra* note 98, at 213.

may disappear on one island after another, even if some islands have the surplus population that could serve to recolonize temporarily unpopulated islands. As a result, random chance will eventually lead to the extinction of the species from all islands, and the extinction of the species as a whole.

The severe fragmentation of mussel populations, and the elimination of suitable habitat between those isolated populations, means that, based on this analysis, mussel populations are more likely to become extinct for two reasons: 1) the islands of suitable habitat have shrunk considerably, through a combination of dams, channelization projects, etc., and thus the populations that each island can support have decreased dramatically (exacerbating the problems discussed above); and 2) the difficulty of mussel individuals moving through the unsuitable habitat to recolonize previously inhabited islands of suitable habitat has increased enormously, perhaps to the point of impossibility. Because host fish, essential to the dispersal of mussel species, may have disappeared from large stretches of rivers and streams, or are unable to move beyond dams or reservoirs that block those rivers or streams, it has become impossible for mussels to move through watersheds to recolonize the remaining patches of suitable habitat. As a result, the fragmented and isolated islands of remaining mussel populations may well disappear, one by one, until the last small population disappears and the species becomes extinct.

H. Lack of Knowledge

As the previous discussion indicates, our knowledge of the threats to native freshwater mussels is limited. Many researchers and managers emphasize that they can only hypothesize about potential or probable threats, that further research is needed, and that, even where threats are relatively well known, the exact mechanisms of how native species are harmed, and thus ways to mitigate or prevent the harm, are unknown. The best knowledge existing may be about the impacts of dams and zebra mussels (perhaps the two largest threats), but in general the lack of knowledge as to how and why mussel species are declining makes any conservation efforts much more difficult.¹⁰⁴

¹⁰⁴ Many of the recovery plans contain as high priority actions (priority level 1 or 2) developing basic research about the mussel species, its life history, and the nature and scope of threats to the species and reasons for its decline. See, e.g., CAROLINA HEELSPLITTER RECOVERY PLAN, *supra* note 12, at 9–10, 17; CRACKING PEARLYMUSSEL RECOVERY PLAN, *supra* note 12, at 9–10; U.S. FISH AND WILDLIFE SERV., HIGGINS' EYE RECOVERY PLAN 34–35 (1983) [hereinafter HIGGINS' EYE RECOVERY PLAN]; U.S. FISH AND WILDLIFE SERV., RECOVERY PLAN: ARKANSAS FATMUCKET MUSSEL 9, 14 (1992); U.S. FISH AND WILDLIFE SERV., APPALACHIAN ELKTOE RECOVERY PLAN 11–12, 19 (1996) [hereinafter APPALACHIAN ELKTOE RECOVERY PLAN]; U.S. FISH AND WILDLIFE SERV., PURPLE CAT'S PAW PEARLYMUSSEL RECOVERY PLAN 8–9, 17 (1990) [hereinafter PURPLE CAT'S PAW PEARLYMUSSEL RECOVERY PLAN].

IV. OVERVIEW OF THE ENDANGERED SPECIES ACT

The ESA was passed in 1973 by Congress,¹⁰⁵ and it remains the primary legal tool the federal government can use to protect and conserve threatened and endangered species in the United States and elsewhere. The Act is essentially divided into two parts: one dealing with actions of the federal government and another dealing with actions by all other parties.

A. The Listing Process and Critical Habitat (Section 4)

The trigger to the application of the ESA is the listing of a species as threatened or endangered under section 4 of the Act.¹⁰⁶ Using the “best scientific and commercial data available,”¹⁰⁷ the government can list species as endangered (“any species which is in danger of extinction throughout all or a significant portion of its range”)¹⁰⁸ 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”).¹⁰⁹ A number of procedures must be followed by the responsible federal agencies in listing species, and the government must respond to petitions to list species.¹¹⁰ The same process applies to the delisting of species when listing is no longer believed to be warranted.¹¹¹ All of the legal protections that apply to species and their habitat flow from the consequence of a species being listed under section 4.

In the course of listing a species, the responsible federal agencies must consider whether to designate critical habitat¹¹²—areas that are “essential to the conservation of the species and which may require special management considerations or protection” and any other areas that are “essential for the conservation of the species.”¹¹³ A complex procedure, similar to that for listing a species, must be followed in the designation of critical habitat and in the revision of designations of critical habitat.¹¹⁴ As with listing, petitions may be filed for the revision of critical habitat.¹¹⁵

¹⁰⁵ Endangered Species Act of 1973, Pub. L. No. 93-205, 87 Stat. 884 (codified at 16 U.S.C. §§ 1531–1544 (2000)). The Act has been amended a number of times, in 1976, 1978, 1979, 1982, and 1988. Endangered Species Act of 1973, amendments, Pub. L. No. 94-359, 90 Stat. 911 (1976); Endangered Species Act Amendments of 1978, Pub. L. No. 95-632, 92 Stat. 3751; Endangered Species Act of 1973, appropriation authorization, Pub. L. No. 96-159, 93 Stat. 1225 (1979); Endangered Species Act Amendments of 1982, Pub. L. No. 97-304, 96 Stat. 1411; Endangered Species Act Amendments of 1988, Pub. L. No. 100-478, 102 Stat. 2306.

¹⁰⁶ 16 U.S.C. § 1533 (2000).

¹⁰⁷ *Id.* § 1533(b)(1)(A).

¹⁰⁸ *Id.* § 1532(6).

¹⁰⁹ *Id.* § 1532(20).

¹¹⁰ *See id.* § 1533(b)(3) (detailing the government’s obligations upon receiving petition of interested person to list or delist a species).

¹¹¹ *Id.* § 1533(c)(2).

¹¹² *Id.* § 1533(a)(3). Unlike listing decisions, the designation of critical habitat requires the consideration of economic factors. *Id.* § 1533(b)(2).

¹¹³ *Id.* § 1532(5)(A).

¹¹⁴ *Id.* § 1533(a)(3)(B).

¹¹⁵ *Id.* § 1533(b)(3)(D).

B. Restrictions on and Requirements of Federal Agencies (Section 7)

Once a species is listed, a number of restrictions on federal actions apply, primarily under ESA section 7.¹¹⁶ All federal agencies must “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.”¹¹⁷ This “jeopardy” standard is used to measure most federal actions. Also, all federal agencies must ensure that their actions will not “result in the destruction or adverse modification of [critical] habitat of such species.”¹¹⁸ Agencies are required to consult with the Service as to whether their actions will jeopardize the existence of a species or adversely modify critical habitat,¹¹⁹ and the Service must provide a written opinion (frequently termed a “biological opinion”) to the agency after consultation as to whether the action will cause jeopardy, adversely modify critical habitat, or cause the incidental take¹²⁰ of an individual of a listed species.¹²¹ The opinion must detail “how the agency action affects the species or its critical habitat,” and if “jeopardy or adverse modification is found, the Secretary shall suggest those reasonable and prudent alternatives which he believes” would avoid those results.¹²² If no jeopardy or adverse modification is found, then the Secretary shall provide a statement that outlines the incidental take that might occur, any reasonable and prudent measures that should be applied, and any associated terms and conditions to implement those reasonable and prudent measures.¹²³

Any federal action that causes jeopardy or adversely modifies critical habitat is absolutely barred from proceeding¹²⁴ unless an exemption is granted by the Endangered Species Committee,¹²⁵ a cabinet-level committee that must follow its own set of complicated procedures, including balancing the costs and benefits of the federal action and the harm to the species.¹²⁶

¹¹⁶ *Id.* § 1536.

¹¹⁷ *Id.* § 1536(a)(2).

¹¹⁸ *Id.* The definition of what “critical habitat” truly is, and what it means to “adversely modify” critical habitat, has been the subject of great judicial, legislative, and regulatory confusion. See the discussion in MICHAEL J. BEAN & MELANIE J. ROWLAND, *THE EVOLUTION OF NATIONAL WILDLIFE LAW* 251–62 (3d ed. 1997).

¹¹⁹ 16 U.S.C. § 1536(a)(2) (2000).

¹²⁰ “Take” is defined in the statute as meaning “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect or to attempt to engage in any such conduct.” *Id.* § 1532(19). See discussion *infra* in text accompanying note 140.

¹²¹ 16 U.S.C. § 1536(3)–(4) (2000).

¹²² *Id.* § 1536(3)(A).

¹²³ *Id.* § 1536(4).

¹²⁴ *Tennessee Valley Authority v. Hill (TVA v. Hill)*, 437 U.S. 153, 193–94 (1978) (imposing injunction on federal government preventing it from completing a dam that would cause the extinction of a listed species, despite large sunk costs in the construction of the dam).

¹²⁵ Sometimes called the “God Squad.”

¹²⁶ 16 U.S.C. § 1536(h) (2000). The Committee has only granted two exemptions to section 7 prohibitions in its history. One of those exemptions was a result of a litigation settlement, and the government withdrew the other after a change in administration. BEAN & ROWLAND, *supra* note 118, at 264 n.337. Procedures for an exemption are outlined in 16 U.S.C. § 1536(g)–(h) (2000). The Committee was created in reaction to the Supreme Court’s decision in *TVA v. Hill*.

Prior to the initiation of formal consultation, all agencies must request a list of species in the area to be affected by the proposed action, and then must conduct a biological assessment "for the purpose of identifying any endangered species or threatened species which is likely to be affected by such action."¹²⁷ This information is then used in the consultation process, if there is a finding that a species is "likely to be affected by such action."¹²⁸ Otherwise, there is no need for consultation.¹²⁹

The Act also imposes some affirmative duties on the government, including requiring all agencies to take steps to further the purposes of the Act,¹³⁰ and requiring the Service to "develop and implement plans . . . for the conservation and survival of endangered species and threatened species."¹³¹ These are known as "recovery plans,"¹³² and are required to have "site-specific management actions . . . necessary to achieve the plan's goal for the conservation and survival of the species,"¹³³ "objective, measurable criteria"¹³⁴ for the delisting of species, and "estimates of the time required and the cost to carry out those measures needed to achieve the plan's goal."¹³⁵ These recovery plans are generally used to structure the Service's scientific, law enforcement, and management efforts to conserve and protect listed species, and eventually to rebuild their populations to allow for delisting.¹³⁶ However, the effectiveness and implementation of recovery plans will generally not be closely reviewed by courts; in general, the courts have deferred to the Service's interpretation of whether plans meet the statutory requirements, how to implement plans, and whether to change them.¹³⁷

BEAN & ROWLAND, *supra* note 118, at 242-44, 263-64.

¹²⁷ 16 U.S.C. § 1536(c)(1) (2000).

¹²⁸ *Id.* For the purposes of determining whether a biological opinion is needed, the Service uses the standard of whether the action "is not likely to adversely affect" the species. (If the action is likely to adversely affect the species, formal consultation and a biological opinion will be required.) The Service counts "beneficial effects," "insignificant effects," and "discountable effects," (where the action is reasonably not expected to occur or be measured) as "not likely to adversely affect" the species. U.S. FISH & WILDLIFE SERV. & NAT'L MARINE FISHERIES SERV., ENDANGERED SPECIES ACT CONSULTATION HANDBOOK ch. 3.5 (1998) [hereinafter HANDBOOK].

¹²⁹ 50 C.F.R. §§ 402.12(k), 402.14(b) (2000).

¹³⁰ 16 U.S.C. § 1536(a)(1) (2000). This section has been interpreted by the courts to have much less bite than section 7(a)(2). See BEAN & ROWLAND, *supra* note 118, at 236-39.

¹³¹ 16 U.S.C. § 1533(f)(1) (2000).

¹³² *Id.*

¹³³ *Id.* § 1533(f)(1)(B)(i).

¹³⁴ *Id.* § 1533(f)(1)(B)(ii).

¹³⁵ *Id.* § 1533(f)(1)(B)(iii).

¹³⁶ While the Service must prepare recovery plans, most courts have held that there is no requirement that the Service must follow through on all of the proposals in the recovery plan. BEAN & ROWLAND, *supra* note 118, at 210-12.

¹³⁷ See, e.g., Nat'l Audubon Soc'y v. Hester, 801 F.2d 405, 408 (D.C. Cir. 1986) (rejecting challenge to Service decision to bring all wild condors into captivity, despite provisions of current recovery plan); Strahan v. Linnon, 966 F. Supp. 111, 115 (D. Mass. 1997) (determining that "the timing for development of [recovery] plans is discretionary"); Fund for Animals v. Babbitt, 903 F. Supp. 96, 106-10 (D.D.C. 1995) (deferring to Service's interpretation of what the "site-specific management action" requirement entails, and upholding that portion of the grizzly bear recovery plan); Or. Natural Res. Council v. Turner, 863 F. Supp. 1277, 1282-84 (D. Or. 1994)

*C. Prohibitions Against Private Actions and Exceptions
(Sections 9 & 10)*

All persons in the United States (including federal, state, and local governments) are prohibited from “taking” any individual of a listed species under section 9 of the ESA.¹³⁸ Take is defined by the statute as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.”¹³⁹ “Take” has been interpreted by the regulations of the Service to include habitat modification or degradation “where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.”¹⁴⁰ Thus, the take prohibition has become a powerful tool to restrict development, land use, hunting, and other private activities that might cause the extinction of listed species. It has also become extremely controversial because of its potentially wide scope, and its potential threat to private landowner rights.

The blanket prohibition against taking can be avoided by filing for an exception under section 10 of the Act, which allows for “incidental take” by individuals.¹⁴¹ To obtain the permit, the applicant must submit a “conservation plan” that shows the impact likely to result from the taking, the steps to be taken to minimize and mitigate the impacts of the taking and the funding for those steps, alternatives to the action causing the take that were considered and rejected, and any other requirements the Secretary may impose.¹⁴² If the Secretary finds that the conservation plan does show that the taking is incidental, that it will minimize and mitigate impacts “to the maximum extent possible,” that it provides adequate funding, that the “taking will not appreciably reduce the likelihood of the survival and recovery of the species in the wild,” and the plan makes any other assurances necessary, the permit must be granted.¹⁴³ This process, which has come to be known as the “habitat conservation plan” (HCP) process, has increasingly been used by the Service in the past ten years to add regulatory flexibility to the section 9 program.¹⁴⁴ The Service has also added a number

(holding that there is a duty to prepare a recovery plan, but the plans only offer discretionary guidance); *Nat'l Wildlife Fed'n v. Nat'l Park Serv.*, 669 F. Supp. 384, 388 (D. Wyo. 1987) (holding that plans only offer discretionary guidance). *But see Fund for Animals*, 903 F. Supp. at 111–15 (holding that Service failed to provide objective, measurable criteria for delisting species, and had not provided scientifically valid monitoring methods and population targets); *Sierra Club v. Lujan*, 36 *Env'tl Rep. Cas. (BNA)* 1533, 1541–51 (W.D. Tex. Feb. 1, 1993) (requiring government to develop recovery plan for listed species); *see also* Jason M. Patlis, *Recovery, Conservation and Survival Under the Endangered Species Act: Recovering Species, Conserving Resources, and Saving the Law*, 17 *PUB. L. & RESOURCES L. REV.* 55, 85 (1996) [hereinafter Patlis, *Recovery, Conservation, and Survival*].

¹³⁸ 16 U.S.C. § 1538(a)(1)(B) (2000).

¹³⁹ *Id.* § 1532(19).

¹⁴⁰ Final Redefinition of “Harm,” 46 *Fed. Reg.* 54,748, 54,750 (Nov. 4, 1981). This interpretation was upheld by the Supreme Court in *Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*, 515 U.S. 687, 691 (1995).

¹⁴¹ 16 U.S.C. § 1539(a)(1)(B) (2000).

¹⁴² *Id.* § 1539(a)(2)(A).

¹⁴³ *Id.* § 1539(a)(2)(B).

¹⁴⁴ *See, e.g.,* Karin P. Sheldon, *Habitat Conservation Planning: Addressing the Achilles Heel*

of regulatory provisions to its HCP program, including guaranteeing that commitments by permit applicants will not be increased during the term of the HCP permit (“No Surprises”).¹⁴⁵

V. CURRENT APPLICATION OF THE ENDANGERED SPECIES ACT TO FRESHWATER MUSSELS

A. Use of the ESA to Prevent Harm (Sections 7, 9, & 10)

1. Critical Habitat

What is perhaps most remarkable about the application of the ESA to freshwater mussels by the Service is that, of the three major regulatory tools available for the protection of species (the section 9 “take” prohibition combined with HCP exemptions, critical habitat designation, and section 7 consultation), two have not been used *at all* in the context of freshwater mussels. There is not a single freshwater mussel species with critical habitat designated for it,¹⁴⁶ although as of January 2002, two species did have proposed critical habitat designations pending.¹⁴⁷

The Service’s rationale for not designating critical habitat (which is generally required by the ESA when a species is listed) for many of the mussel species has been that designation is “not prudent” because of the risk of collection and vandalism (either through direct destruction, or through the use of toxic chemicals placed in water to kill mussels), that designation is not possible because critical habitat is not determinable, or that designation of critical habitat would not result in any benefit to the species.¹⁴⁸ Whether these rationales are based on real world problems or are

of the Endangered Species Act, 6 N.Y.U. ENVTL. L.J. 279, 308–13 (1998).

¹⁴⁵ *Id.* at 315–16. The section 9 prohibition of take also applies to the federal government, but a separate “incidental take” exemption process applies to actions by the federal government. This process is incorporated into the regular section 7 consultation process. The Service in its biological opinion will provide an estimate of incidental take, and the mandatory measures the agency must follow to avoid a jeopardy or adverse modification finding under section 7 will also be sufficient to immunize the agency against section 9 liability. 16 U.S.C. § 1536(o)(2) (2000).

¹⁴⁶ See U.S. Fish and Wildlife Serv., *Threatened and Endangered Species System, Listed Species with Critical Habitat as of 11/02/2001*, at <http://ecos.fws.gov/webpage> (last visited Nov. 2, 2001). In the recovery plan for the Higgins’ Eye Mussel, the Service did designate “essential habitat” areas—areas that were proposed to serve as critical habitat for purposes of section 7 under the ESA. These areas were “defined as those localities that are believed to currently contain viable reproductive populations” of the species that were “the best chances for the continued survival of the species.” HIGGINS’ EYE RECOVERY PLAN, *supra* note 104, at 38. However, the Service never implemented the recommendations of the biologists who wrote the recovery plan.

¹⁴⁷ Proposed Designation of Critical Habitat for the Appalachian Elktoe, 66 Fed. Reg. 9540 (Feb. 8, 2001); Proposed Designation of Critical Habitat for the Carolina Heelsplitter, 66 Fed. Reg. 36,229 (July 11, 2001).

¹⁴⁸ See, e.g., Final Rule to List the Ouachita Rock-Pocketbook (Mussel) as an Endangered Species, 56 Fed. Reg. 54,950, 54,956 (Oct. 23, 1991) (citing risk of collection and vandals using poisons in waterways); Determination of Endangered Status for the Cumberland Pigtoe Mussel, 56 Fed. Reg. 21,084, 21,086 (May 7, 1991) (citing no additional benefit to designation and risk of

instead a cover for political decisions to avoid designating critical habitat is unclear. The Service has used similar rationales for an enormous number of species in the past.¹⁴⁹ Commentators and courts have expressed skepticism about whether vandals and collectors really pose such a threat to the endangered and threatened species of the United States.¹⁵⁰ Mussels are

collection); "*Lasmigona decorata*" (Carolina Heelsplitter) Determined to be Endangered, 58 Fed. Reg. 34,296, 34,930 (June 30, 1993) (citing both lack of benefit and risk of collection); Determination of Endangered Status for the Winged Mapleleaf Freshwater Mussel, 56 Fed. Reg. 28,345, 28,348 (June 20, 1991) (citing lack of benefit); Endangered Status for Eight Freshwater Mussels and Threatened Status for Three Freshwater Mussels in the Mobile River Drainage, 58 Fed. Reg. 14,330, 14,338 (Mar. 17, 1993) (designation not now determinable because of lack of knowledge); Determination of Endangered Status for the Northern Riffleshell (*Epioblasma torulosa rangiana*) and the Clubshell Mussel (*Pleurobema clava*), 58 Fed. Reg. 5638, 5641 (Jan. 22, 1993) (finding that mussels are highly vulnerable to vandalism, particularly due to intentional pollution, and the impact "could be catastrophic," and that designation is not determinable); Appalachian Elktoe Determined to be an Endangered Species, 59 Fed. Reg. 60,324, 60,333 (Nov. 23, 1994) (finding that designation would add no known benefit because it would not add to section 7 consultation process, and would increase risk of collection and vandalism "during the often controversial critical habitat designation process"); Determination of Threatened Status for the Inflated Heelsplitter; *Potamilus inflatus*, 55 Fed. Reg. 39,868, 39,870 (Sept. 28, 1990) (finding designation is not prudent because it would not add any benefit to the species); Determination of Endangered Status for Five Freshwater Mussels and Threatened Status for Two Freshwater Mussels from the Eastern Gulf Slope Drainages of Alabama, Florida and Georgia, 63 Fed. Reg. 12,664, 12,684-85 (Mar. 16, 1998) (finding designation is not prudent because it would not add any benefit to the species, because process "can arouse concern and resentment on the part of private landowners and other interested parties" who might vandalize mussel species which are "especially vulnerable to vandalism" because they are in shallow rivers, "relatively immobile," in "remote but easily accessed areas," and "sensitive to a variety of easily obtained commercial chemicals and products," and because the species are primarily found on private land where landowner cooperation might be crucial and designation of critical habitat "could affect" that cooperation); Determination of Endangered Status for the Cumberland Elktoe, Oyster Mussel, Cumberlandian Combshell, Purple Bean and Rough Rabbitsfoot, 62 Fed. Reg. 1647, 1655 (Jan. 10, 1997) (finding designation is not prudent because it would not add any benefit and would increase risk of vandalism).

However, the Service's attitude towards designation of critical habitat for endangered mussels may be changing. In the course of listing a new mussel species in the fall of 2001, the scaleshell mussel, the Service indicated that it would be moving towards the designation of critical habitat for the species in the near future. Determination of Endangered Status for the Scaleshell Mussel, 66 Fed. Reg. 51,322, 51,338 (Oct. 9, 2001) (stating that the Service "find[s] that critical habitat designation is prudent for the scaleshell mussel," but adding that the Service will not immediately designate critical habitat because of a lack of resources, but has decided to list the species without designation to increase the protection available for the species).

¹⁴⁹ See, e.g., James Salzman, *Evolution and Application of Critical Habitat Under the Endangered Species Act*, 14 HARV. ENVTL. L. REV. 311, 333 tbl.2 (1990) (noting that vandalism, risk of taking, collectors, and collections were listed as reasons for not designating critical habitat for almost all species for which critical habitat was not listed, which at the time was four out of every five species listed under the ESA); GEN. ACCOUNTING OFFICE, ENDANGERED SPECIES ACT: TYPES AND NUMBER OF IMPLEMENTING ACTIONS 28 (1992) [hereinafter TYPES AND NUMBER OF IMPLEMENTING ACTIONS].

¹⁵⁰ See Oliver A. Houck, *The Endangered Species Act and its Implementation by the U.S. Departments of Interior and Commerce*, 64 U. COLO. L. REV. 277, 306 (1993) [hereinafter Houck, *Implementation*] ("The vision of hordes of vandals, collectors, and tourists swarming over the landscape in search of endangered species, most of which will die before they are taken home, is, to put it charitably, exaggerated. Interior's own personnel do not believe it."); Salzman, *supra* note 149, at 333 ("[T]he proposition that collectors or vandals pose an overwhelming threat to

sedentary and therefore more vulnerable to capture by humans and to harm from intentional chemical spills by individuals seeking to eliminate listed species.¹⁵¹ Identification of critical habitat on large maps in contentious public hearings, at least one biologist argued, could inspire heat of the moment attacks on listed species by angry local residents.¹⁵² On the other hand, mussels are often small, hidden in the gravel or sand of rivers, difficult to identify to species level without professional training, and located in sometimes hard to access rivers and streams.¹⁵³ Whether vandalism is a real threat for most species probably depends on whether the species is particularly restricted in range, easy to find, or in small streams that are vulnerable to use of chemicals such as bleach.¹⁵⁴ The second rationale that critical habitat does not benefit listed species depends on the Service's own interpretations of the Act.¹⁵⁵ The third rationale that information is not available may well be accurate for many mussel species,¹⁵⁶ but would not necessarily prevent the designation of at least some critical habitat where it is certainly known to be important.

2. Section 9

There has not been a single HCP approved for the protection of freshwater mussels,¹⁵⁷ which is a strong indication that section 9 is not being applied against private landowners, at least with regards to habitat destruction, since the section 10 HCP process is the only means by which

four out of every five species listed . . . is hard to believe."); Conservation Council for Hawaii v. Babbitt, 2 F. Supp. 2d 1280, 1283 (D. Haw. 1998) (rejecting the Service's "not prudent" and not beneficial determination for critical habitat for 245 species of listed Hawaiian plants, because there was no evidence of vandalism and because critical habitat designation provides significant legal protection); Thomas F. Darin, *Designating Critical Habitat Under the Endangered Species Act: Habitat Protection Versus Agency Discretion*, 24 HARV. ENVTL. L. REV. 209, 224-27 (2000) (discussing cases where courts have rejected the "not prudent" rationale for failing to designate critical habitat); Heather Weiner, *Going Through the Motions: Fish and Wildlife Service's Critical Habitat Moratorium*, ENDANGERED SPECIES UPDATE, May-June 1998, at 40, 45. See generally Jack McDonald, *Critical Habitat Designation Under the Endangered Species Act: A Road to Recovery?*, 28 ENVTL. L. 671 (1998) (discussing recent Ninth Circuit cases that required the Service to designate critical habitat).

¹⁵¹ Hartfield Interview, *supra* note 33; Interview with Fisheries Biologist, U.S. Fish and Wildlife Serv. (Apr. 19, 2001); see also April 19 Biologist Interview, *supra* note 59 (describing a conversation with a county commissioner who (presumably joking) asked how much Chlorox bleach would be required to kill off the listed mussels in a mussel bed in the county).

¹⁵² April 19 Biologist Interview, *supra* note 59.

¹⁵³ See Bogan Interview, *supra* note 33; April 11 Biologist Interview, *supra* note 54; Morrison Interview, *supra* note 54.

¹⁵⁴ Telephone Interview with Biologist, U.S. Fish and Wildlife Serv. (Apr. 17, 2001) [hereinafter April 17 Biologist Interview].

¹⁵⁵ See *infra* Part VII.

¹⁵⁶ See *supra* Part III.H.

¹⁵⁷ Telephone Interview with Marjorie Nelson, Biologist, U.S. Fish and Wildlife Serv., Division of Endangered Species, Arlington, Virginia (Dec. 6, 2000). In 18 interviews conducted with government and academic biologists, state wildlife officials, and environmental lawyers, no one had heard of any HCP ever being approved for an endangered mussel species.

private activity that causes “take” can proceed.¹⁵⁸ Interviews with Service staff confirmed that section 9 has not been used at all with respect to actions by private landowners on private lands abutting streams, and that it has been used relatively little with respect to direct habitat alteration in streams or direct harvesting of listed mussel species.¹⁵⁹ Most federal enforcement against individuals illegally poaching mussels (both listed and non-listed) has been through the use of the Lacey Act, which prohibits the interstate transport of wildlife captured in violation of state law.¹⁶⁰ Statements by the Service itself also appear to indicate that section 9 is not being used with respect to land-use activities such as mining, agriculture, silviculture, fishing, and general development activity. In response to comments expressing concern over the impact that the listing of mussel species might have on local communities, the Service has consistently stated that it believes that all of these ongoing activities are not, and will not be, in violation of section 9.¹⁶¹

¹⁵⁸ A number of authors have made the connection between enforcement of section 9 take prohibitions and the actual use of the HCP process by private landowners. See, e.g., Robert D. Thornton, *Searching for Consensus and Predictability: Habitat Conservation Planning Under the Endangered Species Act of 1973*, 21 ENVTL. L. 605, 647 (1991) (“If the proposed activity did not result in a ‘taking’ under section 9, after all, there would be no need for a section 10(a) permit.”); MICHAEL J. BEAN ET AL., RECONCILING CONFLICTS UNDER THE ENDANGERED SPECIES ACT: THE HABITAT CONSERVATION PLANNING EXPERIENCE 41–43 (1991) [hereinafter RECONCILING CONFLICTS UNDER THE ENDANGERED SPECIES ACT] (calling for more stringent enforcement of section 9 taking prohibitions to encourage greater use of the HCP process); LAURA C. HOOD, FRAYED SAFETY NETS: CONSERVATION PLANNING UNDER THE ENDANGERED SPECIES ACT § 3 (1995) (recommending that enforcement of section 9 be strengthened “to encourage more landowners to develop HCPs”).

¹⁵⁹ No Service biologist reported section 9 being used as an enforcement tool against private landowners whose land practices might be causing harm to the water quality of listed species through nonpoint runoff. Section 9 has been used to some extent in other circumstances. One biologist reported that the Service has been using threats of section 9 enforcement against private gravel mining operations in Pennsylvania and other Midwestern locations and forcing the Corps of Engineers to reinstate consultation regarding its permitting programs for dredging and gravel mining in the Ohio River Basin. Morrison Interview, *supra* note 54; see also Watters Interview, *supra* note 54 (stating that state and federal enforcement efforts appear to be focused on point sources and poachers); April 17 Biologist Interview, *supra* note 154 (stating that law enforcement personnel within the Service have not been enthusiastic about investigating and pursuing ESA violations with respect to freshwater mussels).

¹⁶⁰ See Morrison Interview, *supra* note 54 (section 9 has been used to some extent against harvesters and buyers of freshwater mussel shells, primarily to encourage the avoidance of any incidental take of listed species); Bogan Interview, *supra* note 33 (the threat of enforcement of section 9 of the ESA, the Lacey Act, and state laws has been very effective in reducing illegal harvesting); Hartfield Interview, *supra* note 33 (stating that there is “no benefit to a commercial harvester in picking up a listed species, in keeping the shell, because that may mean a few dollars in his pocket, but if he’s caught it’s a fine of hundreds or thousands of dollars,” that buyers and processors of mussel shells would have an equally strong incentive to refuse to purchase listed mussel shells from harvesters, and that many experienced musselers have learned to identify and avoid listed species). Some states have also undertaken aggressive enforcement efforts, including the use of 24-hour patrols of mussel beds by state fish and wildlife officers, and the deployment of night vision goggles. Watters Interview, *supra* note 54; Morrison Interview, *supra* note 54.

¹⁶¹ For example, in the Federal Register listing notice for the Appalachian Elktoe, which included an assertion that “there are still activities occurring within the watershed that continue

3. Section 7

The one major ESA regulatory tool to prevent harm to endangered species that is actively used by the Service is the section 7 consultation process. A large number of the direct threats to freshwater mussels occur through the dredging or filling of waterways. These activities (including gravel mining, navigation channel dredging, bridge construction, and wetland fills) require a permit from the Army Corps of Engineers under section 404 of the CWA.¹⁶² The granting of the permit by the Army Corps constitutes a federal action for the purposes of section 7, triggering the ESA consultation process.¹⁶³

There are also a number of other federal actions that could pose threats to freshwater mussels, and would theoretically need to proceed through the section 7 consultation process. These would include: the permitting of sewage wastewater treatment plants by the Environmental Protection Agency (EPA) under the CWA, the permitting of point source water discharges under the CWA, the approval of state water quality standards by the EPA under the CWA, the permitting of surface mining by EPA Office of Surface Mining (or by state agencies to whom this authority has been delegated), forest management plans and actions (including logging) by the United States Forest Service,¹⁶⁴ management of federal lands by the National

to adversely affect the quality” of the waters where mussels exist, the Service also stated that it was “not aware of any information currently available that indicates existing discharges associated with mining industry in Mitchell County, North Carolina, or the town of Spruce Pine are either adversely affecting the Appalachian Elktoe or resulting in a ‘take’ of the species where it presently exists” in those same watersheds. Appalachian Elktoe Determined to be an Endangered Species, 59 Fed. Reg. 60,324, 60,328–29 (Nov. 23, 1994); *see also* Determination of Endangered Status for Five Freshwater Mussels and Threatened Status for Two Freshwater Mussels from the Eastern Gulf Slope Drainages of Alabama, Florida and Georgia, 63 Fed. Reg. 12,664, 12,678 (Mar. 16, 1998) (stating that listing of freshwater mussel species will have little impact on agriculture and forestry because “[m]ost of these activities are not directly regulated or monitored by the Service or other Federal agencies, and are, therefore, unlikely to be affected”); *id.* at 12,686 (stating that normal agricultural activities, silvicultural practices, and commercial fishing, as long as compliant with existing regulations and best management practices, “will not result in a violation of section 9”); Determination of Endangered Status for the Cumberland Elktoe, Oyster Mussel, Cumberlandian Combshell, Purple Bean, and Rough Rabbitsfoot, 62 Fed. Reg. 1647, 1650 (Jan. 10, 1997) (noting that the listings of 24 federally listed mussels in the Tennessee and Cumberland river systems “have not had a significant impact on private lands activities (e.g., logging, agriculture, land development, and home construction”). “In fact most individuals that own or farm lands along streams that are inhabited by listed aquatic species are unaware of the species’s existence because their presence has never affected their activities.” 62 Fed. Reg. at 1650.

¹⁶² Federal Water Pollution Control Act, 33 U.S.C. § 1344 (1994). Many of the biologists interviewed stated that they considered Corps permitting to be one of the most important federal actions in terms of potential harm to freshwater mussels.

¹⁶³ *See* HANDBOOK, *supra* note 128, ch. 3 (setting out the guidelines regarding the consultation process).

¹⁶⁴ Several of the biologists interviewed indicated that National Forest land management practices were generally far superior to private land practices, and that the threat to mussels from Forest Service activities was much less compared to other federal actions. Hartfield Interview, *supra* note 33; Tolin Interview, *supra* note 33; *see also* April 27 Biologist Interview, *supra* note 56 (stating that mussel populations in streams in National Forests tend to be among

Park Service adjacent to and including waterways containing freshwater mussels, operation of dams and locks by the Army Corps of Engineers, the Tennessee Valley Authority, and the Bureau of Reclamation, and the licensing of dams by the Federal Energy Regulatory Commission. Thus, even assuming that section 9 is never invoked by the Service, there remain a large number of federal actions (or private actions licensed by the federal government) that could pose threats to endangered mussels and could be evaluated in the context of section 7.

To determine the extent to which the section 7 consultation process is being used to protect freshwater mussels, in the spring of 2001, biologists responsible for the section 7 consultation process from the three Service regions that have the most endangered freshwater mussel species populations¹⁶⁵ were asked 1) to provide representative biological opinions for formal section 7 consultations they had undertaken in the recent past for freshwater mussels, 2) what type of consultation work they had undertaken for specific federal permits or activities (listed above) that had the potential to threaten freshwater mussels, 3) what that consultation involved in terms of reasonable and prudent mitigation measures or jeopardy findings, and 4) the relative level of formal versus informal consultation they undertook.¹⁶⁶ Several Service biologists were also asked to determine how they perceived the section 7 consultation process to be working, and how effective it was.

a. Coverage of Federal Actions by Section 7 Consultation

All of the biologists felt strongly that the section 7 process was being followed—either formally or informally—for most of the significant federal actions that might harm mussels.¹⁶⁷ However, the biologists did indicate that for federal programs that have been delegated to states—in particular, permitting of point sources under the CWA, and the permitting of surface mining—consultation was less frequent.¹⁶⁸

the healthiest).

¹⁶⁵ These regions are Region 4 (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, Puerto Rico, South Carolina, Tennessee, and the Virgin Islands), Region 5 (Connecticut, Washington D.C., Delaware, Massachusetts, Maryland, Maine, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, Virginia, Vermont, and West Virginia), and Region 3 (Iowa, Illinois, Indiana, Michigan, Minnesota, Missouri, Ohio, and Wisconsin).

¹⁶⁶ Informal consultation does not fall under the deadlines of the ESA that apply to formal consultation, and it is supposed to occur between the agency and the Service to determine whether a species is present in the area of the action, and whether that action is likely to adversely affect the species or its critical habitat. 16 U.S.C. § 1536(a)(3) (2000). If the action is likely to adversely affect the species or its critical habitat, then formal consultation is required. See HANDBOOK, *supra* note 128, ch. 3 (in the course of informal consultation, an agency may be able to modify the proposed action to avoid any adverse effect and thus avoid formal consultation).

¹⁶⁷ See April 17 Biologist Interview, *supra* note 154 (indicating he believed that section 7 had been doing “an excellent job in at least minimizing impacts” and that most agencies were “very cooperative” in complying with section 7 consultation requirements).

¹⁶⁸ See Hartfield Interview, *supra* note 33 (stating that there had been difficulties in getting state agencies to consult or to agree to implement reasonable and prudent measures with

This reduced level of consultation for federal environmental programs delegated to state agencies results from serious legal uncertainties about whether section 7 applies to such programs. For instance, almost all of the CWA permitting of point sources in the United States has been delegated to state agencies.¹⁶⁹ Under the CWA, EPA still retains review authority over those permits and water quality standards. Currently, the Service and EPA assert that when EPA reviews these point source permits, EPA must consult with the Service regarding section 7 of the ESA.¹⁷⁰ Both agencies also argue that EPA retains the authority to require states to consult with the Service regarding compliance with the ESA and to revoke or alter permits or standards that the Service finds violate section 7 of the ESA.¹⁷¹ However, at least one appeals court has held that the CWA does not grant EPA this authority and that EPA cannot require a state to consult with the Service under section 7 of the ESA to receive delegated authority to grant point source permits under the CWA.¹⁷² While EPA has maintained that the decision was wrongly decided,¹⁷³ it has since abandoned attempts to directly require state permitting authorities to consult with the Service regarding the ESA.¹⁷⁴ Instead, EPA is planning to draft national water quality standards that will ensure that water quality throughout the country will “not likely jeopardize the continued existence of Federally-listed species or destroy or adversely modify designated critical habitat.”¹⁷⁵ EPA will consult with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (collectively the Services) regarding these national standards.¹⁷⁶ In the course of its triennial review of state water quality standards, EPA will then require states to alter their water quality standards to meet or exceed this new national standard, thus ensuring that state water quality standards will

respect to point source permitting and state water quality standards); April 19 Biologist Interview, *supra* note 59.

¹⁶⁹ As of October 2001, 48 of 50 states had been delegated authority by EPA to administer point source discharge permit programs. EPA, Office of Wastewater Management, at <http://www.epa.gov/owm> (last visited Oct. 29, 2001).

¹⁷⁰ “The agencies believe that [s]ection 7 [of the ESA] applies when EPA carries out actions approving State or Tribal water quality standards and NPDES permitting programs under the [CWA].” U.S. Fish & Wildlife Serv., *Section 7 Consultation: Questions and Answers Regarding the Clean Water Act and the Endangered Species Act*, at <http://www.endangered.fws.gov/consultations/epamoa.html> (last visited Oct. 29, 2001).

¹⁷¹ See Elizabeth Rosan, *EPA’s Approach to Endangered Species Protection in State Clean Water Act Programs*, 30 ENVTL. L. 447, 468–69 (2000) (outlining the process by which EPA would utilize its authority to approve state NPDES programs to ensure states consult with the Service regarding ESA compliance). *But see id.* at 479 n.254 (noting the courts appear to have held that EPA’s veto of a state CWA permit is not a federal action and, therefore, would not be covered by ESA section 7).

¹⁷² *Am. Forest & Paper Ass’n v. EPA*, 137 F.3d 291, 297–98 (5th Cir. 1998).

¹⁷³ Draft Memorandum of Agreement Between the Environmental Protection Agency, Fish and Wildlife Service, and National Marine Fisheries Service Regarding Enhanced Coordination Under the Clean Water Act and the Endangered Species Act, 64 Fed. Reg. 2742, 2746 (Jan. 15, 1999) [hereinafter Draft Memorandum].

¹⁷⁴ *Id.* at 2745.

¹⁷⁵ *Id.* at 2744.

¹⁷⁶ *Id.* at 2744–45.

not jeopardize listed species.¹⁷⁷ Under the CWA, permit programs for states will be required to meet these state water quality standards, essentially forcing state point source discharge permits to also meet the “not likely to jeopardize” standard.¹⁷⁸ EPA will still be required to consult with the Services when it is reviewing state water quality standards that do not meet that national standard to protect listed species, or when new species are listed.¹⁷⁹ Essentially, EPA will be using its authority to set national water quality standards and to require state permit programs to meet those standards, thereby forcing the states in effect to meet the ESA’s section 7 requirements.¹⁸⁰

The current effort of EPA and the Services to implement ESA protections into the CWA will take a substantial amount of time to bear fruit, if it is ever successful, because of the indirect route by which ESA protections will eventually be implemented through permit restrictions (national water quality standards, translated into state water quality standards, translated into reductions in state permits). Moreover, the legal case for the proposed changes could be weak; arguably, the new procedures violate substantive provisions of the ESA.¹⁸¹

Whatever the future results of the Draft Memorandum, the ESA has had little impact on past discharges under the CWA. EPA did not believe that the ESA applied to its review of delegated state permit programs until 1994.¹⁸² At that time, EPA and the Service reversed positions in a settlement of an Alabama lawsuit and promised to enter into formal consultations on state water quality standards and other elements of delegated state permits.¹⁸³ Thus, mussel species might have been significantly harmed by discharges of permitted point sources throughout the United States without benefit of protection under the ESA.¹⁸⁴ Given the significance that water quality has for freshwater mussels, the lack of any incorporation of the ESA into CWA implementation could pose a serious obstacle to protecting freshwater mussels.¹⁸⁵

¹⁷⁷ *Id.* at 2745.

¹⁷⁸ *Id.* at 2745–46.

¹⁷⁹ *Id.* at 2745.

¹⁸⁰ Rosan, *supra* note 171, at 463. Keith G. Wagner, *State NPDES Programs and the ESA: Protecting Listed Species Under the Clean Water Act*, 23 ENVIRONS ENVTL. L. & POL’Y J. 3, 33 (1999). EPA’s new approach has yet to be tested in court, although EPA has gone to great lengths to distinguish this new program from the approach that was struck down in the Fifth Circuit. Draft Memorandum, *supra* note 173, at 2746; Rosan, *supra* note 171, at 472–74.

¹⁸¹ Rosan, *supra* note 171, at 475–76. Rosan argues that the Draft Memorandum faces formidable legal challenges since it relies on a nation-wide consultation that fails to give adequate consideration to individual water bodies. Without site-specific evaluations of information and effects on individual listed species, Rosan states that the Draft Memorandum fails to provide for species survival and recovery.

¹⁸² Wagner, *supra* note 180, at 25–26.

¹⁸³ *Id.*

¹⁸⁴ However, several biologists stated that they believed the improved water quality resulting from the CWA’s regulation of point sources has benefited freshwater mussels, particularly in the Ohio River. Hartfield Interview, *supra* note 33; Watters Interview, *supra* note 54.

¹⁸⁵ See *supra* Part III (analyzing the current human threats to survival of freshwater mussels).

Similar issues have arisen in the context of surface mining regulation, which is also generally delegated by the federal government to the states. For example, formal consultation has not been required in Kentucky or Tennessee for surface mining projects, despite the great potential harm those activities can pose to freshwater mussels. Indeed, the Kentucky Office of Surface Mining does not even acknowledge that its permitting activities are subject to ESA consultation.¹⁸⁶

b. Effects of Section 7 Consultation on Federal Actions that Are Reviewed

Of the twenty-eight section 7 consultations (as well as two supplemental consultations) examined for this Comment, eleven involved the construction of bridges across rivers that contained populations of endangered mussels.¹⁸⁷ Others involved state agencies stocking fish in reservoirs and streams, construction of docking facilities for boats, a national forest management plan, redevelopment of federal lands in a watershed containing freshwater mussels, and the approval of New Jersey's water quality standards.¹⁸⁸ Thus, consultations covered a wide range of federal activities.

Almost all of the reviewed consultations allowed the proposed actions to proceed with no determination that jeopardy would result from the federal action, and all of the projects were allowed to proceed. Reasonable and prudent measures that were required to reduce incidental take from the federal actions included: use of best management practices by the construction crews, siltation fences, restrictions on the times and dates of construction, translocation of mussels from locations that are to be directly affected by the construction, land-use restrictions on federal property in particularly sensitive areas, and the use of buffer zones between streams and logging or mining activities.¹⁸⁹

None of the projects reviewed for this Comment were halted as a result of the consultation process. To the author's knowledge, there have been only two federal projects that have ever resulted in a jeopardy opinion as a result of freshwater mussels:¹⁹⁰ the completion of the Columbia Dam on the

¹⁸⁶ Letter from the Cookeville Field Office, U.S. Fish and Wildlife Serv., to Eric Biber as an e-mail attachment (Feb. 20, 2001) (on file with author). This is probably a result of the fact that the surface mining regulatory program has been delegated by the federal government to a number of states, including Kentucky, raising the same issues as in the context of CWA point source permitting and ESA consultation. Similar problems were also reported by the Service endangered species biologist in West Virginia. See Tolin Interview, *supra* note 33 (mentioning lack of formal consultation with coal mining projects). One biologist interviewed characterized coal mining as an activity that appears to be highly unregulated in practice. April 27 Biologist Interview, *supra* note 56.

¹⁸⁷ See *infra* Table 1.

¹⁸⁸ See *infra* Table 1 and accompanying citations.

¹⁸⁹ See *infra* Table 2 and accompanying citations; see also Letter from the Cookeville Field Office, *supra* note 186 (listing protective measures the Service generally recommends for projects involving mussels listed under the ESA).

¹⁹⁰ April 19 Biologist Interview, *supra* note 59.

Duck River in Tennessee was blocked in the 1970s because of a number of endangered mussel species,¹⁹¹ and the Corps's proposal for maintaining the navigation channel on the Upper Mississippi River was found to jeopardize the existence of the Higgins' eye mussel.¹⁹² This latter proposal was allowed to proceed through the application of reasonable and prudent measures and was one of the biological opinions reviewed for this Comment.

Mitigation measures appear to generally involve minimizing the direct impacts of construction projects, or translocation¹⁹³—it is less common for the measures to require long-term monitoring, mitigation of impacts away from the direct footprint of construction projects, or prevention of future harm.¹⁹⁴ However, one biologist told of a project where a jeopardy opinion

¹⁹¹ Michael J. Bean, *Conserving Endangered Species by Accident: The Duck River Experience*, in *THE BIG KILL: DECLINING BIODIVERSITY IN AMERICA'S LAKES AND RIVERS* 111, 114–18 (David S. Wilcove & Michael J. Bean eds., 1994). Unlike the more famous episode at Tellico, this dam controversy did not reach the Supreme Court and, surprisingly, never stirred national controversy, perhaps because the compromise achieved between TVA and the Service was to allow the dam to proceed if TVA was successful in restoring mussel populations elsewhere. *Id.* at 116–17. TVA never was successful, and the dam was never completed. The land around the dam is now a preserve area, *see id.* at 120, and the partial transfer of that land was the subject of one of the biological opinions cited in Table 1. For the litigation and controversy surrounding the Columbia Dam, see George Cameron Coggins & Irma S. Russell, *Beyond Shooting Snail Darters in Pork Barrels: Endangered Species and Land Use in America*, 70 *GEO. L.J.* 1433, 1455–56 (1982), and *Pacific Legal Foundation v. Andrus*, 9 *Envtl. L. Rep.* (Envtl. L. Inst.) 20,413 (M.D. Tenn. 1979), *aff'd*, 657 F.2d 829 (6th Cir. 1981).

¹⁹² U.S. Fish and Wildlife Serv., Biological Opinion for the Operation and Maintenance of the 9-Foot Navigation Channel on the Upper Mississippi River Channel System 115 (May 15, 2000).

¹⁹³ *See also* April 11 Biologist Interview, *supra* note 54 (pointing out examples of bank stabilization projects where project applicants have moved all of the activities out of the river line in order to avoid mussel impacts); April 27 Biologist Interview, *supra* note 56 (stating that the long-term benefit of translocation is suspect and that it is not a catch-all solution for problems, but it is commonly used as a means of removing mussels from harm's way).

¹⁹⁴ Monitoring that is required appears to be aimed only at mussels that have been specifically translocated to avoid the impact of projects. *See, e.g.*, U.S. Fish and Wildlife Serv., Cookeville Field Office, Biological Opinion for Endangered Species Approval for the Rescue of Critically Endangered Mussels 11–12 (Oct. 1996) (requiring monitoring of endangered mussels removed from the wild and placed in captivity); U.S. Fish and Wildlife Serv., Cookeville Field Office, Biological Opinion for the Proposed City of Florence Municipal Treated Sewage Outfall, Tennessee River (TRM 254.7) Lauderdale County, Alabama 5–6 (Oct. 1994) [hereinafter BiOp for City of Florence] (requiring monitoring of translocated endangered mussels twelve months after translocation to avoid construction of a sewage outfall); U.S. Fish and Wildlife Serv., Pennsylvania Field Office, Letter Serving as Biological Opinion for Proposed Replacement of Kennerdell Bridge 26 (Feb. 3, 1998) [hereinafter BiOp for Replacement of Kennerdell Bridge] (on file with author) (requiring monitoring of translocated mussels for three years after bridge project); U.S. Fish and Wildlife Serv., Vermont Field Office, Letter Serving as Biological Opinion for U.S. Route 2 Reconstruction 7 (Nov. 19, 1996) [hereinafter BiOp for U.S. Route 2 Reconstruction] (on file with author) (requiring monitoring of translocated mussels for two years after bridge project). Other projects involved monitoring the direct impact of the project on mussels in the immediate vicinity of the project, particularly with regard to projects involving the construction of docks or establishment of mooring places along the Ohio River. *See* U.S. Fish and Wildlife Serv., West Virginia Field Office, Letter Serving as Draft Biological Opinion to Joe S. Towing Company 18–19 (Mar. 18, 1997) (on file with author) (requiring monitoring of impacts on mussel bed); U.S. Fish and Wildlife Serv., West Virginia Field Office, Letter Serving as Biological Opinion for Letart Corporation Barge Loading Facility 15 (Mar. 16, 1999) (on file with author); U.S. Fish and Wildlife Serv., West Virginia Field Office, Letter

for a highway project in the Charlotte area was possible because of the development the project would have triggered, and the resulting harm to the Carolina heelsplitter, a listed mussel species. The jeopardy determination was avoided by the requirement of habitat restoration and protection in the watershed in question.¹⁹⁵ Another biologist described success in convincing a state highway department to modify the design of a bridge to eliminate direct runoff from the bridge into the river; as a result, any chemical spills from accidents on the bridge (a significant threat in this region) would run onto the land, instead of onto the prime mussel habitat in the river.¹⁹⁶

For the majority of projects that do not go through formal consultation (and therefore do not produce biological opinions that could be reviewed),¹⁹⁷ even the informal consultation process can result in significant protective measures by federal agencies¹⁹⁸—there may be relatively simple measures or changes those agencies can make to avoid any harmful impacts on listed mussel species, and thus any need for formal consultation. In addition, the consultation process in the 1990s is surely more rigorous than the consultation process for freshwater mussels in the 1970s, when other federal agencies simply ignored jeopardy or take findings by the Service.¹⁹⁹

Serving as Biological Opinion for Richard and Sons' Barge Loading Facility 9-10 (Aug. 18, 1999) (on file with author).

In contrast, one mitigation measure required research on the impacts of Tennessee's fish stocking program on listed fish and mussel species. Memorandum from Assistant Regional Division (AES), U.S. Fish and Wildlife Serv., to Assistant Regional Division (FA) (Feb. 14, 1996) [hereinafter FWS/R4/AES/FA] (on file with author). Another required research on the impacts of nuclear power plants effluent on mussels. U.S. Fish and Wildlife Serv., Cookeville Field Office, Biological Opinion for the Proposed Operation of the Watts Bar Nuclear Power Plant, Rhea County, Tennessee 5 (Mar. 1995). Two other biological opinions required monitoring of zebra mussel invasions in the Upper Mississippi and St. Croix Rivers. See U.S. Fish and Wildlife Serv., Biological Opinion for the Operation and Maintenance of the 9-Foot Navigation Channel of the Upper Mississippi River Channel 121-23, 141-43 (May 15, 2000); U.S. Fish and Wildlife Serv., Letter Serving as Biological Opinion For Draft Cooperative Management Plan for the Lower St. Croix National Scenic Riverway 15 (undated) (on file with author). A number of biologists interviewed indicated they felt that the monitoring requirements imposed on projects had been rather successful in gathering important biological information. See, e.g., April 11 Biologist Interview, *supra* note 54 (monitoring and long-term studies yielded useful scientific information).

¹⁹⁵ April 19 Biologist Interview, *supra* note 59.

¹⁹⁶ Koch Interview, *supra* note 54.

¹⁹⁷ Letter from the Cookeville Field Office, *supra* note 186. For example, most projects that go through the section 7 consultation process in Kentucky and Tennessee do not go through formal consultation.

¹⁹⁸ See Telephone Interview with Angela Boyer, Staff Biologist, Ohio Field Office, U.S. Fish and Wildlife Serv. (Apr. 19, 2001) [hereinafter Boyer Interview] (discussing positive outcomes where early coordination and involvement in planning process occurred); see also Hartfield Interview, *supra* note 33 (indicating that consultation had helped improve land management practices on National Forests in the Southeast significantly); April 27 Biologist Interview, *supra* note 56 (stating that most of the best mussel populations are often left in small streams in National Forests, indicating good land management practices); April 17 Biologist Interview, *supra* note 154 (indicating that a number of highway bridge projects have been altered through the informal consultation process to avoid construction in the riverbed).

¹⁹⁹ One biological opinion from the 1970s was sent to the author of this Comment by Glenn Smith, a biologist at the Service, as an example of an opinion that was ignored by the consulting

However, the section 7 consultation process is limited to dealing with projects on an individual, project-by-project basis.²⁰⁰ As a result, it is difficult for the Service to address the larger-scale, cumulative, and indirect impacts that result from some federal projects.²⁰¹ Thus, many of the mitigation measures involved with section 7 are focused on the prevention of direct impacts from construction projects directly in the footprint of mussel habitat through translocation, changes in timing and location of construction activities, monitoring, and the use of mitigation measures such as siltation fences.²⁰² The Service itself has characterized the impact of section 7 consultation in the context of freshwater mussel protection as requiring “only minor project changes or modifications” as “necessary to protect the species” in the “majority of the cases involving listed mussels.”²⁰³ The section 7 consultation process in general does not appear to address more systemic threats to freshwater mussels, such as land use and

federal agency. The biological opinion found that relocation of 1.3 miles of the Clinch River in Virginia, which required a permit from the U.S. Army Corps of Engineers, would jeopardize the existence of a number of endangered mussels. U.S. Fish and Wildlife Serv., Letter Serving as Biological Opinion for Relocation of 1.3 miles of the Clinch River 2 (May 17, 1978) (on file with author). Mr. Smith indicated that the project occurred unmodified as far as he knew. Note from Mr. Smith attached to above Biological Opinion, to Eric Biber (on file with author).

²⁰⁰ 16 U.S.C. § 1536(a) (2000).

²⁰¹ April 27 Biologist Interview, *supra* note 56.

²⁰² See *infra* Table 2. All of the sediment controls required by Biological Opinions reviewed for this Comment involved restrictions on the impacts directly due to construction, including restrictions on the location of construction, requirements for vegetation restoration, use of best management practices, monitoring of siltation levels on downstream mussel beds, and use of filters on water runoff. See, e.g., U.S. Fish and Wildlife Serv., Letter Serving as Biological Opinion for Route 665 Bridge Replacement 15–16 (Oct. 28, 1999) (imposing relatively stringent sediment controls, including time restrictions on instream work, filtering and upland disposal of all water removed from instream construction sites, prohibition on mechanized work instream, minimization of vegetation removal, use of state best management practices, and revegetation with native species in the area); U.S. Fish and Wildlife Serv., Letter Serving as Biological Opinion for Route 649 Bridge Replacement 7–8 (Sept. 8, 1998) (on file with author) (requiring time restrictions on instream work, prohibition on mechanized work instream, minimization of vegetation removal, use of state best management practices, and use of dewatering mechanism to reduce siltation from instream construction).

²⁰³ See Appalachian Elktoe Determined to Be an Endangered Species, 59 Fed. Reg. 60,324, 60,326–29 (Nov. 23, 1994) (responding to comments from local residents and politicians concerned about the impact of listing of the species); see also Determination of Endangered Status for the Cumberland Pigtoe Mussel, 56 Fed. Reg. 21,084, 21,087 (May 7, 1991) (“[I]t has been the experience of the Service that nearly all section 7 consultations can be resolved so that the species is protected and the project objectives are met.”); Determination of Endangered Status for Five Freshwater Mussels and Threatened Status for Two Freshwater Mussels from the Eastern Gulf Slope Drainages of Alabama, Florida and Georgia, 63 Fed. Reg. 12,664, 12,685 (Mar. 16, 1998) (same); Determination of Endangered Status for the Cumberland Elktoe, Oyster Mussel, Cumberlandian Combshell, Purple Bean, and Rough Rabbitsfoot, 62 Fed. Reg. 1647, 1651 (Jan. 10, 1997) (“[I]t has been the Service’s experience, after dealing with hundreds of mining projects, that in nearly all cases where there is a conflict between endangered species and a mining project, the project is permitted with only minor modifications.”); *id.* (“It is possible that a few in-stream dredging and gravel mining projects could be impacted due to the presence of one of these species. However, it has been the experience of the Service that most of these projects can be designed in such a way . . . that the project objectives and the needs of the species can be met.”).

development patterns in upland areas that might affect water quality, which could be addressed by requiring stringent water quality standards for sewage or point source outfalls, or implementing stringent, monitored and long-term controls on sedimentation and runoff from logging or mining activities.²⁰⁴ Thus, the nature of the section 7 process itself, which is focused on individual projects, rather than overall programs—an individual bridge construction here, a barge mooring facility there—makes it difficult for the Service or the federal agency involved in the consultation to take a larger and more holistic view. The individual project is not responsible (at least to a significant degree) for land-use changes, deteriorating water quality, or increased risk of exotic species invasion, and therefore, it is outside the scope of the law (and probably unfair to the individual project applicant) to place the burden of correcting such systemic problems on that applicant. Even large-scale, individual projects (where larger-scale, more systematic threats might be addressed) may cause problems in the section 7 process, because the sheer scope of the consultation process (and the possible costs of modifying the project to avoid jeopardy) may deter agencies from consulting.²⁰⁵

While the Service might be able to stretch the section 7 process to require such larger-scale, longer-term, and systemic mitigation measures in a few cases (or at least to require some funding of larger-scale mitigation measures by most applicants),²⁰⁶ the Service's current interpretation of section 7 effectively precludes such efforts. Under the current regulations, if a project is determined to result in the jeopardy of a species,²⁰⁷ the Service has the choice of either preventing the action, or of designating "reasonable and prudent alternatives" to the action that would avoid jeopardy. However,

²⁰⁴ This assessment of the Service's section 7 consultation process is shared by some scientists who have worked on the conservation of freshwater mussels. Strayer Interview, *supra* note 92; see also Hartfield Interview, *supra* note 33 (agreeing that the consultation process can sometimes be considered "piecemeal"). However, Service biologists indicated that indirect impacts can be incorporated into the section 7 process, and pointed out examples (such as the Charlotte highway project discussed in the text accompanying note 195) in which reasonable and prudent measure requirements have addressed the larger indirect impacts from a project. Indeed, the Service's Consultation Handbook calls for the consideration of indirect effects. HANDBOOK, *supra* note 128, at 4-27 to 4-28.

²⁰⁵ Morrison Interview, *supra* note 54 (detailing how the scope of the consultation process may deter agencies from consulting). In particular, the Corps of Engineers has been reluctant to reinstate consultation over its permitting, navigation, and dredging programs in the Ohio River basin, and apparently has only been prompted to start the informal consultation process after threats of law-enforcement actions by the Service. *Id.*

²⁰⁶ The option of requiring section 7 applicants to pay funds to mitigate the larger-scale harms their projects might have on specific listed species has been used in other contexts by the Service. To avoid blocking water projects on the Upper Colorado River in the 1980s, the Service allowed federal agencies to pay funds toward the recovery programs for three endangered Colorado River fish species. GEN. ACCOUNTING OFFICE, ENDANGERED SPECIES: LIMITED EFFECT OF CONSULTATION REQUIREMENTS ON WESTERN WATER PROJECTS 28-29 (1987) [hereinafter LIMITED EFFECT OF CONSULTATION REQUIREMENTS] (describing this "Windy Gap" system).

²⁰⁷ Adverse modification of critical habitat will never occur for a listed mussel species, since no critical habitat has been designated for any listed species. See discussion *infra* Part VI.

those actions must be “implemented in a manner consistent with the intended purpose of the action,” must be able to be “implemented consistent with the scope of the action agency’s legal authority and jurisdiction,” and must be “economically and technologically feasible.”²⁰⁸ These requirements will mean that there may be no alternatives available. The Handbook provides examples of alternatives that can not be required, including locating a permit in uplands instead of requiring a Corps permit to fill a wetland (because the alternative is not under consideration), or requiring actions on lands over which the action agency has no jurisdiction or authority to enforce compliance (such as local land-use regulation on private lands).²⁰⁹

Similar considerations apply to requirements the Service might impose on federal actions where there is no jeopardy, but where there will be incidental take. The Service has the power to require reasonable and prudent measures to minimize the impact of incidental take as part of the granting of an incidental take statement to the applicant agency. However, these same limitations exist on the use of reasonable and prudent measures in this context, as the definition remains the same. Indeed, the Handbook specifically notes that the economic feasibility requirement for reasonable and prudent measures will mean that very different mitigation measures will be required for a “single family boat dock” where “the effect of measures costing \$10,000 or \$100,000 may be critically significant” than for a “multi-million dollar development complex.”²¹⁰

Where mitigation requirements would jeopardize the economic or technological feasibility of the project, cause a fundamental change in the nature of the project, or require actions by nonregulated parties, the Service must choose to either allow the project to proceed, or to prevent it altogether with a jeopardy finding. Given the small number of projects that are known to be halted by the Service through the section 7 process in general,²¹¹ it seems a reasonable presumption that there are situations in

²⁰⁸ 50 C.F.R. § 402.02 (2000); see also HANDBOOK, *supra* note 128, at 4-41.

²⁰⁹ HANDBOOK, *supra* note 128, at 4-42. The Service biologists interviewed agreed that these limitations did exist, but in general felt that the limitations were only fair, because applicants could not be required to undertake more than their share of the burden for minimizing or mitigating impacts, and that the law did not require the imposition of infeasible measures. Instead, if only infeasible options were available, a jeopardy opinion should be issued. See Hartfield Interview, *supra* note 33 (explaining circumstances in which jeopardy opinion should be issued); Tolin Interview, *supra* note 33 (same).

²¹⁰ HANDBOOK, *supra* note 128, at 4-50; see also Houck, *supra* note 150, at 321-29 (noting that current regulations for the consultation process mean that jeopardy findings are avoided, and any mitigation required for jeopardy findings are tailored to minimize the economic impact on the applicant). “Taken together, Interior’s regulations present a composite picture of an agency doing everything possible within law, and beyond, to limit the effect of protection under section 7(a)(2).” *Id.* at 326.

²¹¹ See Houck, *supra* note 150, at 317-21 (listing halted projects); WORLD WILDLIFE FUND, FOR CONSERVING LISTED SPECIES TALK IS CHEAPER THAN WE THINK: THE CONSULTATION PROCESS UNDER THE ENDANGERED SPECIES ACT 4-6 (1994) (compiling data on section 7 consultations from 1987 through 1992 and finding that of almost 98,000 federal actions that went through formal or informal consultation with the Service, the Service issued only 352 jeopardy opinions, of which only 54 actions were eventually terminated or withdrawn because of section 7). The

which the Service allows the action to continue without any mitigation,²¹² or where the mitigation does not entirely offset the harm caused by the project.²¹³ One example cited by a Service biologist was the expansion of a reservoir that would result in the destruction of prime habitat for one of the largest and healthiest populations of a listed species. While the field biologists did recommend a jeopardy finding, they were overruled by Service headquarters, and the project was allowed to proceed with a combination of translocation and habitat preservation as mitigation, but with prime habitat nonetheless being destroyed.²¹⁴ Even where the process works as it should (and most Service biologists interviewed believed that it worked well most of the time), the section 7 process is limited by its own terms to only a

same study showed that, in Regions 3, 4, and 5, Region 3 did not block a single federal action because of section 7, Region 4 blocked five actions because of section 7 (none due to mussels), and Region 5 blocked one action because of section 7 (unrelated to mussels). *Id.* at 30–36.

National results similar to the World Wildlife Fund study were found by the General Accounting Office (GAO) in a report in 1992. GAO found that 90% of all consultations with the Services were informal consultations, over 90% of all formal consultations did not result in a jeopardy opinion, and 90% of all jeopardy opinions provided reasonable and prudent alternatives to the project. TYPES AND NUMBER OF IMPLEMENTING ACTIONS, *supra* note 149, at 30–32; see also Steven L. Yaffee, *Avoiding Endangered Species Development Conflicts Through Interagency Consultation*, in BALANCING ON THE BRINK OF EXTINCTION 86, 89–94 (Kathryn A. Kohm ed., 1991) (reporting similar results and calling for less politicization, more funding, and more information in the section 7 process). The GAO report was also cited by the Service to argue that the listing of a number of mussel species as endangered or threatened would have a minimal economic impact. Determination of Endangered Status for Five Freshwater Mussels and Threatened Status for Two Freshwater Mussels from the Eastern Gulf Slope Drainages of Alabama, Florida and Georgia, 63 Fed. Reg. 12,664, 12,676 (Mar. 16, 1998).

²¹² Some biologists interviewed expressed concern about the extent to which federal agencies complied with reasonable and prudent measures required in the section 7 process, especially given the shortage of Service staff who monitor compliance. April 19 Biologist Interview, *supra* note 59; Hartfield Interview, *supra* note 33 (stating he was unsure whether the U.S. Forest Service was implementing all of the obligations required through consultation). Some anecdotal reports from within the government as to the faithfulness with which section 7 is followed by various agencies in other circumstances are not encouraging. See Jerome A. Jackson, *The Red-Cockaded Woodpecker Recovery Program: Professional Obstacles to Cooperation*, in ENDANGERED SPECIES RECOVERY: FINDING THE LESSONS, IMPROVING THE PROCESS 157, 166–68 (Tim W. Clark et al. eds., 1994) (describing various incidents where military officials have flouted the section 7 consultation process and actively sought to remove endangered woodpeckers from military bases).

²¹³ A Service biologist described one example of a proposed coal mine project in West Virginia. The project would have had a number of ponds for the storage of coal slurry and coal washing wastewater, which could have been vulnerable to overflow and spills in the event of heavy rainstorms, threatening good mussel habitat downstream. While the biologist was able to get the impoundments strengthened and expanded to some extent, he felt there was still a risk that a violent thunderstorm could lead to a significant and potentially catastrophic spill. However, additional improvements were not made by the project applicant because of the expense involved. Tolin Interview, *supra* note 33.

²¹⁴ April 17 Biologist Interview, *supra* note 154. The biologist also noted that the habitat preservation undertaken by the project applicant—the purchase of riparian buffer easements—was greatly hampered by the clear-cutting of most of the relevant properties by landowners when they discovered the applicant was about to purchase the easement rights. *Id.* This biologist did indicate that this was the only case he was aware of where jeopardy had been avoided because of political pressure. *Id.*

subset of all the actions that might harm freshwater mussels (those that involve a federal nexus) and is limited in the mitigation and minimization measures that it can require of those projects.²¹⁵

Section 7 is considered a powerful tool by the Service biologists that implement it, because it can allow (if the agency applicant is willing) for the use of creative measures to minimize and mitigate harm from projects.²¹⁶ The section 9 take prohibition (combined with the HCP process) also has the potential to provide significant protection for mussel species.²¹⁷ In particular, the flexible, broad-based, and large-scale approach of at least some HCPs might allow for better and more proactive mitigation for listed mussel species,²¹⁸ and it could certainly address a set of activities that section 7 cannot address. However, the exemption process for section 9 (the section 10 HCP process) is generally considered by developers and project applicants to be considerably more difficult to use than the section 7 process (either because the process takes significantly longer, or because the substantive requirements are tougher to meet).²¹⁹ The implication is that

²¹⁵ See Houck, *supra* note 150, at 317–21 (reviewing almost 100 jeopardy opinions issued in late 1992 and determining that almost all provided reasonable and prudent alternatives that were “within the economic means, authority and ability of the applicant”); see also LIMITED EFFECT OF CONSULTATION REQUIREMENTS, *supra* note 206, at 30 (consultations carried out under the ESA have had little effect on Western water projects). Almost all of the mitigation required in the projects reviewed involved translocation of mussels away from the direct footprint of the project. See *infra* Table 2; see also, e.g., BiOp for City of Florence, *supra* note 194, at 5 (requiring translocation of endangered mussels to avoid harm from the construction of a sewage outfall); BiOp for Replacement of Kennerdell Bridge, *supra* note 194, at 26 (requiring translocation of mussels away from bridge project); BiOp for U.S. Route 2 Reconstruction, *supra* note 194, at 8 (requiring translocation of mussels away from bridge project). Houck concluded after his study that “there is no evidence that formal consultation under the Endangered Species Act is stopping the world. Indeed, there is little evidence that it is changing it very much at all.” Houck, *supra* note 150, at 321.

²¹⁶ See Tolin Interview, *supra* note 33 (describing recovery plan options).

²¹⁷ Currently, the critical habitat provision of the ESA appears to provide little or no additional protection, at least under the Service's current interpretation of the law and its regulations. For a discussion of the current scope of critical habitat protection, whether it should be significantly expanded, and whether such expansion would provide additional protection for listed species, see *infra* Part VI.

²¹⁸ Examples are the large-scale, ecosystem-wide community planning HCPs that have been implemented in portions of California. See, e.g., Craig Manson, *Natural Communities Conservation Planning: California's New Ecosystem Approach to Biodiversity*, 24 ENVTL. L. 603 (1994) (supporting cooperation among government, environmentalists, and land managers under the Natural Community Conservation Planning Act).

²¹⁹ Several commentators note that the section 7 process is generally considered to be easier than the section 10 process for obtaining permits, at least before the recent changes to the HCP program under the Clinton administration. See, e.g., Andrew A. Smith et al., *The Endangered Species Act at Twenty: An Analytical Survey of Federal Endangered Species Protection*, 33 NAT. RESOURCES J. 1027, 1065 (1993) (noting the complexity of section 10 requirements compared to the “less daunting” section 7 process); Albert C. Lin, *Participants' Experiences with Habitat Conservation Plans and Suggestions for Streamlining the Process*, 23 ECOLOGY L.Q. 369, 430 (1996) (noting that some commentators have argued that section 10 should be made more like section 7 in order to accelerate the section 10 process); Thornton, *supra* note 158, at 653 (arguing that the section 10 process is “simply too cumbersome” and calling for allowing private parties to use the section 7 process); RECONCILING CONFLICTS UNDER THE ENDANGERED SPECIES ACT, *supra* note 158, at 47–48 (noting that many developers “perceive that Section 7 offers a

the section 7 process may have a less general scope, less of an impact on development, and less potential to address wide-ranging harms to mussels than section 9.

B. Recovery Efforts

The other side of the Service's efforts to protect and conserve endangered species under the ESA is the Service's recovery programs—active efforts by the Service to rebuild the populations of listed species so that they can be removed from the ESA's lists. As part of this process, the Service develops recovery plans that it uses to guide its actions (in cooperation with other federal agencies, states, and private organizations and persons) to restore the population (and usually the habitat as well) of the listed species to a point where it no longer requires listing.

1. Content of Recovery Plans

A survey of twenty of the recovery plans developed by the Service for listed mussels, covering twenty-four of the listed species,²²⁰ was undertaken to determine if the recovery plans adequately assessed the threats facing the listed species and provided adequate management steps for recovering the species. These two factors—adequate assessment and management steps—are the most important in ensuring that recovery plans succeed. As Table 3 shows, the recovery plans roughly parallel the literature in assessing the threats to listed species, although exotic species are probably underestimated as a threat in the recovery plans, because the enormous danger posed by the zebra mussel was not broadly recognized until 1990 or 1991, after a number of the plans had been developed.

In developing management steps to implement recovery of the species, however, the recovery plans tend to be on the vague side.²²¹ As Table 4

quicker and perhaps easier solution" than section 10 and that a number of projects have strained the definition of federal action to fall within section 7); Christopher H.M. Carter, Comment, *A Dual Track for Incidental Takings: Reexamining Sections 7 and 10 of the Endangered Species Act*, 19 B.C. ENVTL. AFF. L. REV. 135, 137 (1991) (noting that the section 10 process is much more expensive and time-consuming than the section 7 process); Donald L. Soderburg & Paul E. Larsen, *Obtaining Incidental Take Permits Under the Endangered Species Act: The Section 7 Alternative*, 20 REAL EST. L.J. 3, 5 (1991) (advising real estate lawyers to pursue the "expedient" section 7 route rather than the "rigid and time-consuming procedures" of section 10).

²²⁰ A list of the recovery plans examined can be found accompanying Table 3. All recovery plans issued after 1991 were included in the analysis.

²²¹ Previous commentators have also noted the lack of specificity in many recovery plans. See Timothy H. Tear et al., *Recovery Plans and the Endangered Species Act: Are Criticisms Supported by Data?* 9 CONSERVATION BIOLOGY 182, 184–87, 190–91 (1995) [hereinafter *Recovery Plans and the Endangered Species Act*] (documenting a study of the usefulness of various recovery plans); Douglas W. Schemske et al., *Evaluating Approaches to the Conservation of Rare and Endangered Plants*, 75 ECOLOGY 584, 593–95 (1994) (criticizing recovery plans for listed plants for not providing specific recommendations for the gathering and application of demographic and genetic information, and for setting population objectives for the delisting of species arbitrarily low). Other weaknesses identified in many recovery plans include the setting

shows, many of the plans rely on general exhortations to apply and enforce existing laws to protect mussels, restore habitat and relocate species in more appropriate habitat, research basic biology of the species, and monitor populations. Educating the public on the importance of mussels, captive breeding, and surveying for additional populations are also popular management steps. While all of these steps are essential to the conservation of mussels,²²² most do not specifically address the root causes for the decline.²²³ A major cause for the lack of specificity in the recovery plans might be the lack of general knowledge about which specific threats are causing mussel species to decline;²²⁴ every single recovery plan examined

of recovery targets below what is biologically necessary for long-term survival of a species, failure to consider expanding habitat for species or to make politically difficult choices, the avoidance of key threats to species, and the lack of use of population viability analysis or adequate maps. Timothy H. Tear et al., *Status and Prospects for Success of the Endangered Species Act: A Look at Recovery Plans*, 262 SCIENCE 976, 976 (1993) (noting that 28% of recovery plans set recovery goals at or below the existing population size at the time the plan was written) (“[R]ecover goals have often been set that risk extinction rather than ensure survival.”); Robert Cutler & Robert Blair, *Recovery Planning and Endangered Species*, ENDANGERED SPECIES UPDATE, Aug. 1989, at 2, 2 (noting that about 3% of listed species are actually recovering).

²²² Survey work may be among the most important, and underappreciated, of the tools in the recovery process. The discovery and protection of previously unknown populations allows managers to protect these populations that might have otherwise disappeared; learn more information about the distribution, habitat requirements, and threats facing the species; and, if enough populations are discovered, may lead to delisting of the species. Recent examples of important finds of populations of listed mussel species through survey work include both the tan riffleshell and the purple cat’s paw, the latter of which was the only known reproducing population in the wild. *Regional News & Recovery Updates: Region 5*, ENDANGERED SPECIES BULL., Mar.–Apr. 1997, at 29, 29; see also Leah R. Gerber et al., *Gray Whales and the Value of Monitoring Data in Implementing the U.S. Endangered Species Act*, 13 CONSERVATION BIOLOGY 1215, 1215 (1999) (arguing that monitoring and survey data can cost-effectively lead to better management and listing or delisting decisions). For other examples of implementation of recovery plans for freshwater mussels, see Dan Sparks et al., *Fish Creek Preservation and Restoration*, ENDANGERED SPECIES BULL., Jan.–Feb. 1999, at 12, 12 (describing the rehabilitation of crucial mussel habitat after a pipeline rupture, including research on basic life history of the species, cooperative efforts to reduce runoff from agriculture, education, and wetland restoration); Paul D. Johnson & Robert S. Butler, *Conserving a Treasure of Diversity*, ENDANGERED SPECIES BULL., May–June 1999, at 16, 16 (discussing education and captive propagation efforts); Richard Neves, *Rescuing Ohio River Mussels*, ENDANGERED SPECIES BULL., Mar.–Apr. 1996, at 16, 16 (discussing the removal of mussels from the wild to captive holding facilities to protect endangered species from zebra mussel infestation).

²²³ There are some exceptions. The recovery plans for the Higgins’ eye mussel, the winged mapleleaf mussel, the white cat’s paw pearlymussel, the james spiny mussel, the tar spiny mussel, the clubshell/northern riffleshell, and the 11 mussel species covered in the Mobile River Basin Aquatic Ecosystem Recovery Plan have a higher level of specificity. The winged mapleleaf mussel recovery plan in particular is specific and detailed. One writer argued that the development of new Service guidelines for recovery plans in 1994 might lead to more detailed and specific recovery plans. Patlis, *Recovery, Conservation, and Survival*, *supra* note 137, at 105 (arguing that the draft salmon recovery plan in the Pacific Northwest is particularly detailed and effective, and crediting new Service guidelines). However, there does not appear to be any chronological pattern to the recovery plans that are more or less specific—indeed, some of the plans that are most repetitive were published after 1994. See *infra* note 226 (providing examples of similarly designed recovery plans).

²²⁴ See Box Interview, *supra* note 54 (asserting that the lack of scientific information results

placed research as a high priority for the recovery process.²²⁵ Lack of time or money expended on the plans might also have led to the lack of specificity. A number of plans bore striking similarities, particularly in the management steps recommended, indicating that many of them might have been written in a "cut and paste" method.²²⁶

2. Development and Implementation of Recovery Plans

Unlike section 7 consultations, there is a ready source of information for the current status of the Service's recovery plans for all species. Congress has required the Service to provide an update on the recovery process for all listed species every two years since 1988.²²⁷ The report provides details as to the status of drafting or completing any recovery plan, the stage of recovery plan objectives achieved, and the population status of the species.²²⁸ According to the most recent report available, final recovery plans had been drafted for forty-three of the fifty-seven mussel species included in the report, or seventy-five percent of the species,²²⁹ and the Service had drafted recovery plans for seventy-three percent of all species for which it is responsible.²³⁰ However, only two of eighty mussel species had achieved more than twenty-five percent of the recovery plan objectives (or draft plan objectives, if no final plan had been developed).²³¹ In contrast, for all of the species for which Fish and Wildlife is responsible, twenty-three percent of the species (217 species out of 943) had achieved more than twenty-five percent of the recovery plan objectives.²³²

in weak recovery plans); *Recovery Plans and the Endangered Species Act*, *supra* note 221, at 190 (lack of detailed scientific data on rare species is evident in recovery plans).

²²⁵ See *infra* Table 4.

²²⁶ Compare the management steps for the recovery plans for the Carolina heelsplitter, the Appalachian elktoe, the purple cat's paw, the fanshell, and the cracking pearl mussel, which all bear striking resemblances. CAROLINA HEELSPLITTER RECOVERY PLAN, *supra* note 12, at 6-12; APPALACHIAN ELKTOE RECOVERY PLAN, *supra* note 104, at 7-14; PURPLE CAT'S PAW PEARLYMUSSEL RECOVERY PLAN, *supra* note 104, at 5-12; U.S. FISH AND WILDLIFE SERV., FANSELL RECOVERY PLAN 6-12 (1991) [hereinafter FANSELL RECOVERY PLAN]; CRACKING PEARLYMUSSEL RECOVERY PLAN, *supra* note 12, at 6-12. One of the biologists stated that the similarities among recovery plans were due to the fact that the harms facing most mussels were similar, and that it was more important to get plans written to start funding for recovery, instead of spending time and money developing plans that were not implemented. April 19 Biologist Interview, *supra* note 59; see also Watters Interview, *supra* note 54 (characterizing mussel recovery plans as varying from boilerplate to something quite useful).

²²⁷ 16 U.S.C. § 1533(f)(3) (2000).

²²⁸ U.S. FISH AND WILDLIFE SERV., REPORT TO CONGRESS ON THE RECOVERY PROGRAM FOR THREATENED AND ENDANGERED SPECIES 8 (1996) [hereinafter REPORT TO CONGRESS ON THE RECOVERY PROGRAM].

²²⁹ *Id.* at 14-15.

²³⁰ *Id.* at 5.

²³¹ *Id.*

²³² *Id.* at 8-27.

3. Expenditures

The Service historically provides breakdowns of expenditures by government agencies on the recovery of each listed species for each fiscal year. From Fiscal Year 1989 to Fiscal Year 1993, federal agencies spent an average of \$136,571 per species on recovery for freshwater mussel species. In that same time period, the average expenditure for all listed species was \$1,088,220.²³³ For Fiscal Year 1993 alone, the average expenditure per mussel species was \$71,342, the average for fish was \$976,907 per species, and for birds the average was \$904,727 per species; only snails (\$28,874), amphibians (\$24,495), plants (\$16,721), and crustaceans (\$13,751) were lower.²³⁴

C. Cooperative Efforts and Application of State Laws

The Service biologists interviewed for this Comment emphasized the importance of cooperative efforts, both with private landowners and state agencies, for freshwater mussel protection. The Service's Partners for Fish and Wildlife Program provides technical and financial assistance to private landowners who are voluntarily working to restore habitat of listed and other species, and it has been applied to help protect listed freshwater mussel species.²³⁵ Many of the state and federal agency biologists emphasized the cooperative efforts they have been undertaking.²³⁶ Such cooperative efforts have included the restoration of riparian areas, fencing of streams and rivers to prevent the intrusion of livestock, planting of riparian vegetation in buffer areas along streams and rivers, reduction in the use of pesticides and herbicides, and reduction in erosion from agricultural practices.²³⁷ Indeed, from the interviews it appears that the primary, and perhaps only, way in which nonpoint impacts on mussels are being addressed is through such cooperative efforts.²³⁸ It is difficult to get an impression of how widespread or effective the cooperative efforts have been.²³⁹

Interviewees also emphasized that cooperation between the Service and state agencies is important for the protection of freshwater mussels. In

²³³ A PROMISE BROKEN, *supra* note 3, at 51 (data calculated from Table 5).

²³⁴ *Id.* at 46 (data calculated from Table 4).

²³⁵ Jack Arnold, *Partners for Fish and Wildlife: A New Name for a Growing Program*, ENDANGERED SPECIES BULL., Sept.-Oct. 1998, at 4-5.

²³⁶ See, e.g., Sanders Interview, *supra* note 32.

²³⁷ *Id.*; April 11 Biologist Interview, *supra* note 54; Koch Interview, *supra* note 54; April 17 Biologist Interview, *supra* note 154.

²³⁸ One recovery plan identifies voluntary cooperative efforts as the primary tool in addressing nonpoint threats to mussel species. U.S. FISH AND WILDLIFE SERV., RECOVERY PLAN FOR MOBILE RIVER BASIN AQUATIC ECOSYSTEM 27-28 (2000).

²³⁹ One biologist indicated that cooperative efforts have been relatively limited in scope, primarily because of a lack of funding and staffing within the Service. April 17 Biologist Interview, *supra* note 154. On the other hand, the Service has successfully worked with partners such as The Nature Conservancy and the Soil Conservation Service to pool money and to expand cooperative efforts. April 19 Biologist Interview, *supra* note 59.

many states, the primary protection against gravel mining, for instance, is not through section 7 consultation and the Corps's permitting process, but through state laws and regulations that limit or prohibit instream gravel mining.²⁴⁰ Restrictions on harvesting of freshwater mussels are primarily implemented and enforced (even for listed species) by state agencies.²⁴¹ Service biologists emphasized that an important part of their protection role was not through enforcement of the ESA, but instead through education and outreach to private landowners, providing information and technical support to state agencies to help them enforce state laws that protect mussels, and encouraging those state agencies to more aggressively enforce state laws that protect mussels.²⁴²

D. Status of Freshwater Mussels

As Part II indicated, the conservation status of freshwater mussels is certainly not improving. Despite the fact that a significant number of species have been listed under the ESA since the 1970s (and are therefore eligible for recovery funding and protection under the Act), the number of freshwater mussels considered endangered or threatened by scientists remains enormously high.²⁴³ According to the Service's own Recovery Program Report, only one freshwater mussel species has stable population numbers, and one has increasing population numbers—all others are either extinct, declining, or have an unknown population status.²⁴⁴

VI. PREVIOUS ANALYSIS OF THE REASONS FOR THE SUCCESS OR FAILURE OF THE ESA IN RECOVERING SPECIES

It is clear that, at the very least, the Service is not willing or able to use many of the tools available to it under the ESA to protect freshwater mussels—the recovery plans for freshwater mussels have not been implemented or have been implemented to only a limited extent, and at the same time freshwater mussels continue to decline sharply. From this perspective, the ESA would appear to be underenforced and ineffectual, vindicating the criticisms of the Act. The lack of success with respect to freshwater mussels reinforces the critic's depiction of an act that has failed to recover any significant number of species from the brink of extinction,²⁴⁵

²⁴⁰ Morrison Interview, *supra* note 54.

²⁴¹ *Id.*; Watters Interview, *supra* note 54; Wallace Interview, *supra* note 33.

²⁴² Tolin Interview, *supra* note 33.

²⁴³ See discussion *supra* Part II.

²⁴⁴ REPORT TO CONGRESS ON THE RECOVERY PROGRAM, *supra* note 228, at 14–15.

²⁴⁵ See A PROMISE BROKEN, *supra* note 3, at 29–44 (arguing that not a single species has been removed from the ESA lists because of conservation efforts implemented due to the ESA, and only two species have been downlisted from endangered to threatened through conservation efforts that were undertaken because of the ESA); Sugg, *supra* note 3, at 42 (same); TYPES AND NUMBER OF IMPLEMENTING ACTIONS, *supra* note 149, at 38 (stating that through 1991, only 16 species had been removed from the endangered species list); NOAH'S CHOICE, *supra* note 3, at 245 (arguing that the ESA has failed to implement any actions that have led to the removal of species from the endangered species lists); Charles C. Mann & Mark Plummer, *Is Endangered*

and whose few success stories are in fact due to the efforts of other legislation.²⁴⁶ The critics point out that at the end of 1999, almost thirty years after passage of the ESA, 937 plant and animal species in the United States were listed under the ESA,²⁴⁷ but as of 2001, only twelve species had been removed from the ESA lists because of recovery,²⁴⁸ and as of 1998, less than thirty had been downlisted from endangered to threatened.²⁴⁹ Similar implementation failures have been reported for development of recovery plans,²⁵⁰ implementation of recovery plans,²⁵¹ critical habitat designation,²⁵²

Species Act in Danger?, 267 SCIENCE 1256, 1256-57 (1995) [hereinafter *Is Endangered Species Act in Danger?*] (quoting a critic of the Act from the National Wilderness Institute as stating "not one species can be legitimately claimed as primarily owing its recovery to the Endangered Species Act," and arguing that the ESA has failed to recover species).

²⁴⁶ See A PROMISE BROKEN, *supra* note 3, at 31-34 (arguing that for even the two species that have been downlisted due to conservation efforts by the Service, the conservation activities did not depend on the ESA for implementation); NOAH'S CHOICE, *supra* note 3, at 239-47 (arguing that very few species have been recovered by the ESA and most of those recoveries were not due to actions undertaken by the Act). *But see* Rachlinski, *supra* note 5, at 375-77 (arguing that the data show that the ESA has reversed the trend of decline for many listed species, particularly for those that have been listed the longest under the Act).

²⁴⁷ See ENDANGERED SPECIES BULL., NOV.-DEC. 1999, at 28, 28 (providing a table of listings and recovery plans).

²⁴⁸ U.S. Fish and Wildlife Serv., *Threatened and Endangered Species (TESS) Delisted Species Report as of 10/29/2001*, at http://ecos.fws.gov/webpage/webpage_delisted.html (last visited Oct. 29, 2001).

²⁴⁹ See CONGRESSIONAL RESEARCH SERVICE REPORT FOR CONGRESS, 106TH CONG., REPORT ON ENDANGERED SPECIES LIST REVISIONS: A SUMMARY OF DELISTING AND DOWNLISTING (1998), available at <http://cnie.org> (listing 11 species that have been removed from the ESA lists due to recovery, and 22 species that have been downlisted from endangered to threatened). The Aleutian Canada goose was delisted on March 20, 2001. Final Rule to Remove the Aleutian Canada Goose from the Federal List of Endangered and Threatened Wildlife, 66 Fed. Reg. 15,643, 15,643 (Mar. 20, 2001) (to be codified at 50 C.F.R. pt. 17).

Others have questioned whether the number of species listed or downlisted is a valid reflection of whether the Act is a success or not, pointing out the relatively few listed species that have gone extinct, and the magnitude of the problems of recovering so many threatened and endangered species. See generally Holly Doremus, *Delisting Endangered Species: An Aspirational Goal, Not a Realistic Expectation*, 30 *Envtl. L. Rep. (Envtl. L. Inst.)* 10,434 (2000) [hereinafter Doremus, *Delisting Endangered Species*] (arguing that it is inaccurate to gauge the ESA's success on the number of species delisted); Michael J. Bean, *Looking Back over the First Fifteen Years*, in *BALANCING ON THE BRINK OF EXTINCTION*, *supra* note 211, at 37, 38 ("The ultimate measure of success or failure of [the ESA] . . . is whether the species that are the objects of the Act's concern face a more or less certain future.").

²⁵⁰ In 1992, only 62% of species had recovery plans approved. TYPES AND NUMBER OF IMPLEMENTING ACTIONS, *supra* note 149, at 35. In the same study, over 65% of species with approved plans had to wait at least three years after listing to get an approved plan. *Id.* By 1996, the situation had improved somewhat, with 73% of species having final recovery plans. REPORT TO CONGRESS ON THE RECOVERY PROGRAM, *supra* note 228, at 5 fig.3. As of Feb. 23, 2001, 78% of listed U.S. species had recovery plans prepared for them. U.S. Fish & Wildlife Serv., *General Statistics for Endangered Species*, at <http://ecos.fws.gov/sevlet/TessstatReport> (last visited Oct. 29, 2001) [hereinafter *General Statistics for Endangered Species*]. The content of recovery plans has also been criticized in general. See discussion *supra* note 221.

²⁵¹ A GAO study in 1989 found that, of the species it examined, "many tasks [in the recovery plans] had not been performed." GEN. ACCOUNTING OFFICE, MANAGEMENT IMPROVEMENTS COULD ENHANCE RECOVERY PROGRAM 25 (1989) [hereinafter *MANAGEMENT IMPROVEMENTS*]. As of 1994, the majority of listed species had only less than 25% of the recovery tasks completed. A PROMISE

and listing of species²⁵³ for all of the species under the Act, not just freshwater mussels.

Various explanations have been proposed for the lack of recovery success under the ESA. First, critics argue that the ESA, by attempting to conserve all species,²⁵⁴ effectively conserves none, because it spreads resources too thinly among too many listed species, resulting in underprotection for all, instead of fully recovering some species and allowing others to go extinct.²⁵⁵ What system of "triage" or prioritization should actually be used by the Act to determine which species to protect and which to allow to disappear, however, is less clear.²⁵⁶ Some critics argue that only charismatic, popular species deserve protection;²⁵⁷ others call for

BROKEN, *supra* note 3, at 44 fig. 11.

²⁵² In 1992, only 16% of listed species had critical habitat designated. TYPES AND NUMBER OF IMPLEMENTING ACTIONS, *supra* note 149, at 29. As of Feb. 23, 2001, only 12% of listed species had critical habitat designated. *General Statistics for Endangered Species*, *supra* note 250.

²⁵³ In 1992, about 600 species were listed as "candidate" species by the Service, species that the Service is actively reviewing for possible inclusion on the ESA list. TYPES AND NUMBER OF IMPLEMENTING ACTIONS, *supra* note 149, at 39. As of Feb. 23, 2001, the number of candidate species had decreased to 236. *General Statistics for Endangered Species*, *supra* note 250.

²⁵⁴ One writer described the Act as taking a "theological" step by reflecting a national "commitment to prevent any species of plant or animal from disappearing." Lynn A. Greenwalt, *The Power and Potential of the Act*, in BALANCING ON THE BRINK OF EXTINCTION, *supra* note 211, at 31.

²⁵⁵ Mann and Plummer's book, *Noah's Choice*, has been the leading advocate of this critique of the Act. NOAH'S CHOICE, *supra* note 3, at 247 (arguing that although the Act may have slowed extinctions, "in the long run it will not stave off disaster"); see also Charles C. Mann & Mark L. Plummer, *The Butterfly Problem*, 269 ATLANTIC MONTHLY, Jan. 1992, at 47, 47 [hereinafter *The Butterfly Problem*] (critiquing the ESA for forcing landowners to pay "for the preservation of species they've never heard of"); Smith et al., *supra* note 219, at 1066-69 (arguing that legal and administrative biases against plant species and among animal species results in effective resource allocation); Theodore C. Foin et al., *Improving Recovery Planning for Threatened and Endangered Species*, 48 BIOSCIENCE 177, 183 (1998) (stating that the vast gap between the number of species requiring protection and the resources for protection requires "triage" decisions to allocate funds among species to maximize recovery); Suzanne Winckler, *Stopgap Measures*, 269 ATLANTIC MONTHLY, Jan. 1992, at 74 ("If our goal is to preserve as many kinds of plants and animals as possible, it makes little sense to spend limited funds on heroic steps to rescue a handful of near-extinct species."); NORMAN MYERS, *THE SINKING ARK* 43 (1979) ("Even with a several-times increase in funding to assist threatened species, we could not save all those that appear doomed to disappear."); Donald A. Carr & William L. Thomas, *The Law and Policy of Endangered Species Reauthorization: Noah's Choices and Ecological Mandarins*, 25 ENVTL. L. 1281, 1288 (1995) (echoing Mann and Plummer's critiques); John Charles Kunich, *The Fallacy of Deathbed Conservation Under the Endangered Species Act*, 24 ENVTL. L. 501, 556 (1994) ("[T]he ESA's lack of a priority hierarchy leads to ill-advised interventions and misallocation of scarce resources."); Ann Gibbons, *Mission Impossible: Saving All Endangered Species*, 256 SCIENCE 1386, 1386 (1992) ("Rare plants and animals are slipping through the cracks . . . because federal agencies don't have enough staff or money to list all endangered organisms on a species-by-species basis—much less protect them.").

²⁵⁶ For a discussion of the various types of triage systems that might be employed, see BRYAN G. NORTON, *WHY PRESERVE NATURAL VARIETY* ch. 12 (1987).

²⁵⁷ See Charles C. Mann & Mark L. Plummer, *Empowering Species*, 275 ATLANTIC MONTHLY, Feb. 1995, at 22, 22 [hereinafter *Empowering Species*] (quoting critics as arguing that the Act wastes billions of dollars to save "a cavalcade of [] creatures with absurd-sounding names"); Carr & Thomas, *supra* note 255, at 1291 ("[I]t would be preferable to find a course that does not inevitably, absolutely pit birds, predators, or invertebrates with funny names against people's

focusing on species that are most likely to benefit from recovery efforts (maximal marginal recovery benefits from dollars spent);²⁵⁸ still others argue for focusing on species that are crucial to ecosystem functioning and survival;²⁵⁹ and others argue that priority should be given to species that have the most genetic information or taxonomic uniqueness, or that would protect entire ecosystems.²⁶⁰

Second, the critics argue that the Act is counterproductive, at least when it comes to private lands. Because the Act is solely mandatory and prohibitive, at the very least it creates a disincentive for landowners to take proactive measures to conserve listed species. Increasing the numbers of listed species will result in the risk that landowners will face increased restrictions on their property through the section 9 take prohibition. At the worst, the punitive nature of the ESA toward private landowners engenders hostility and fear, which results in efforts by landowners to illegally and surreptitiously eliminate listed species from their property before the Service can enforce the law against them ("shoot, shovel, and shut up"), and a lack of cooperation (or outright anger) by landowners against the biologists seeking to recover the listed species.²⁶¹ The horror stories and perceived threats against private property rights and extractive industries that the ESA has created has also contributed to the political opposition to

prosperity."); *The Butterfly Problem*, *supra* note 255, at 70 ("If society prefers charismatic megafauna, priority should be given to them without apology."). In *Noah's Choice*, Mann and Plummer appeared to dodge the question of what criteria should be used to make decisions about which species should be saved, instead calling for a process that is ethical, practicable, knowledgeable, and political. NOAH'S CHOICE, *supra* note 3, at 216–24.

²⁵⁸ See Francis R. Thibodeau, *Endangered Species: Deciding Which Species to Save*, 7 ENVTL. MGMT. 101 (1983) (developing a decision tree process for deciding when and how to allocate funding to save an endangered species based on maximizing the effectiveness of spending in protecting endangered species); Foin et al., *supra* note 255, at 178 (calling for analysis to determine which species will benefit the most from conservation expenditures, and prioritizing in that manner).

²⁵⁹ See Kunich, *supra* note 255, at 572–73 (calling for prioritization of species that are crucial to ecosystem survival and functioning); Winckler, *supra* note 255, at 80 (critiquing the ESA for "treating the symptom and not the disease" by focusing too much on saving individual species, instead of preventing extinctions through preserving ecosystems); Smith et al., *supra* note 219, at 1069 ("[P]riority might be given to species of greatest utility in protecting ecosystems and biodiversity, or to those with other important ecological or societal value."); Laura Spitzberg, *The Reauthorization of the Endangered Species Act*, 13 TEMP. ENVTL. L. & TECH. J. 193, 213–16 (1994) (same).

²⁶⁰ See Brian Czech & Paul R. Krausman, *The Species Concept, Species Prioritization, and the Technical Legitimacy of the Endangered Species Act*, 16 RENEWABLE RESOURCES J., Spring 1998, at 17 (arguing that species with larger body sizes should receive preference for protection because they are likely to have more genetic information encoded); Bryan G. Norton, *Avoiding the Triage Question*, ENDANGERED SPECIES UPDATE, June–July 1988, at 1 (advocating protection of those species that have particular ecosystem or functional values).

²⁶¹ See, e.g., David S. Wilcove, *The Promise and the Disappointment of the Endangered Species Act*, 6 N.Y.U. ENVTL. L.J. 275, 277 (1998) (arguing that the punitive nature of the Act "provides no rewards or incentives to encourage good behavior on the part of landowners," contributing in large part to the lack of success of the ESA); John F. Turner & Jason C. Rylander, *Conserving Endangered Species on Private Lands*, 32 LAND & WATER L. REV. 571, 572–73 (1997) (arguing that punitive actions by the ESA against landowners will undermine conservation in the long run).

the ESA.²⁶² This critique of the ESA has produced a wave of suggestions for developing positive incentives for landowners under the ESA, including the use of tax credits and direct payments,²⁶³ the implementation of HCPs (with guarantees that agreements between the landowner and the government will not be overturned without payment (“No surprises”)), and the “safe harbor” program, in which landowners are promised no additional land-use restrictions in return for proactively managing their property to encourage endangered species. Some of these suggestions have prompted actual administrative changes to the ESA’s implementation.²⁶⁴

A substantial number of the threats facing endangered species, however, are beyond the power of the ESA to address through its prohibitions on private actions. Some threats, particularly exotic species, are difficult or impossible for humans to correct.²⁶⁵ The task of controlling a species such as the zebra mussel, which is prolific in reproduction (producing millions or billions of offspring), and spreads by water currents and attachments to boats, seems impossible. Even where the threats may be feasibly dealt with, in many cases they will not be addressed by ESA

²⁶² See, e.g., Jacqueline Lesley Brown, *Preserving Species: The Endangered Species Act Versus Ecosystem Management Regime, Ecological and Political Considerations, and Recommendations for Reform*, 12 J. ENVTL. L. & LITIG. 151, 214–18 (1997) (arguing that the imposition of ESA burdens on private property owners has prompted the rise of the “wise use” movement and congressional opposition to the ESA); Lin, *supra* note 219, at 380–82 (noting the potential for landowners to eliminate endangered species on their property to avoid regulation); *Empowering Species*, *supra* note 257, at 26 (arguing that “overbearing regulation would increase the incentives for landowners to destroy pristine land, with predictably disastrous environmental consequences”); Kunich, *supra* note 255, at 561–65; Sugg, *supra* note 3, at 71–78; *Is Endangered Species Act in Danger?*, *supra* note 245, at 1258; *The Butterfly Problem*, *supra* note 255, at 67–70 (noting that without positive incentives, landowners will have no reason to undertake proactive land management to protect listed species); NOAH’S CHOICE, *supra* note 3, at 187–88 (citing a famous incident where a developer bulldozed a population of an endangered species, the San Diego Mesa Mint, and thereby succeeded in obtaining federal funding for his project); see also REBUILDING THE ARK, *supra* note 2, at 7–8.

²⁶³ See, e.g., Lynne E. Dwyer et al., *Property Rights Case Law and the Challenge to the Endangered Species Act*, 9 CONSERVATION BIOLOGY 725, 737–38 (1995); Kunich, *supra* note 255, at 574–78; SNAPE & FERRIS, *supra* note 2; Robert Bonnie, *Endangered Species Mitigation Banking: Promoting Recovery Through Habitat Conservation Planning Under the Endangered Species Act*, 240 SCI. OF TOTAL ENV’T 11 (1999); Sara Vickerman, *A State Model for Implementing Stewardship Incentives to Conserve Biodiversity and Endangered Species*, 240 SCI. OF TOTAL ENV’T 41 (1999); Spitzberg, *supra* note 259, at 193; Turner & Rylander, *supra* note 261, at 596–604; Daniel A. Hall, *Incentives and Land Acquisition: Key Tools for Restoring Fish and Wildlife Habitat*, ENDANGERED SPECIES UPDATE, May–June 1999, at 53. See generally BUILDING ECONOMIC INCENTIVES INTO THE ENDANGERED SPECIES ACT (Hank Fischer & Wendy E. Hudson eds., 3d ed. 1994).

²⁶⁴ See Richard Stone, *Incentives Offer Hope for Habitat*, 269 SCIENCE 1212, 1212 (1995) (discussing benefits of safe harbor agreements and noting they would be a radical change in ESA enforcement); Michael J. Bean, *Four Sure Ways to Undermine a Good Idea . . . and Hurt Endangered Species*, ENDANGERED SPECIES UPDATE, Nov.–Dec. 1998, at 94 (discussing the benefits and pitfalls of safe harbor agreements); REBUILDING THE ARK, *supra* note 2, at 12–13 (arguing for the safe harbor program as a way to reduce conflicts between landowners and endangered species).

²⁶⁵ See Biber, *supra* note 25, at 386–89, and accompanying footnotes (discussing the difficulties of managing and controlling exotic species).

regulation because the ESA does not (and probably could not) mandate positive actions by private or public actors. Thus, the ESA cannot eliminate the dams that currently have destroyed the vast majority of mussel habitat along the Tennessee and Cumberland Rivers in Kentucky and Tennessee, formerly the best and most diverse mussel communities in North America. Similarly, for the control of exotic species, or the maintenance of natural disturbance patterns (such as fire) that are needed to maintain suitable habitats for certain species, even if such actions are achievable by humans, they often would require positive, proactive management by private and public landowners.²⁶⁶ Critics of the law argue that the punitive nature of the ESA, and its incentive structure, give rise to the inevitable result that no economically rational landowner will ever undertake such actions.²⁶⁷

Another major criticism of the Act has been that it is too oriented on individual species and, as a result, inefficiently wastes time, money, and resources on attempting to save particular species as they become endangered, rather than attempting to protect entire functioning ecosystems and environments. By more proactively and holistically dealing with conservation threats, it is argued, the Act would more efficiently use its resources, saving whole communities of species from extinction rather than dealing with individual species one at a time. As one commentator argued, ecosystems all over the nation are quickly shrinking, but nothing is being done about them until they shrink far enough that a particular species in that ecosystem is listed under the Act: "the Endangered Species Act is treating the symptom and not the disease."²⁶⁸ Thus, there has been an avalanche of proposals to convert (or supplement) the ESA into an Endangered Ecosystems Act, which focuses on preserving whole ecosystems instead of individual species.²⁶⁹ The result, it is argued, would be more efficient,

²⁶⁶ REBUILDING THE ARK, *supra* note 2, at 8–9. A common example used to make this point is that of the red-cockaded woodpecker, which requires timber stands of certain ages and structures (usually maintained by regular fires) to nest and reproduce. *Id.* at 19. However, because fire suppression by humans has eliminated traditional fire patterns in the Southeast, without active management by landowners to produce such timber stands, habitat for the woodpecker is disappearing. *Id.* Without incentives to encourage landowners to produce woodpecker habitat, commentators have argued that the woodpecker is doomed. *Id.*; see also Foin et al., *supra* note 255, at 183 (arguing that "simply preserving habitat will not be sufficient to recover" many species, and active management will be necessary for most species); Doremus, *Delisting Endangered Species*, *supra* note 249, at 10,446–47 (arguing that the threat of exotic species to listed species is not covered by the ESA, and will mean that most species will require active management for the indefinite future).

²⁶⁷ REBUILDING THE ARK, *supra* note 2, at 9; see also *The Butterfly Problem*, *supra* note 255, at 69–70 (articulating concerns by landowners that certain plans are prohibitively expensive); NOAH'S CHOICE, *supra* note 3, at 210 (stating that landowners in the Austin area began to "deliberately mismanag[e] their land" in order to avoid attracting listed endangered birds to their property, including deep-plowing their land to eliminate all trees that might harbor future bird populations) (emphasis in original).

²⁶⁸ Winckler, *supra* note 255, at 80.

²⁶⁹ See, e.g., *id.* at 80–82 (discussing the trend of ecosystem-based thinking among environmental scientists and policy makers); Ronald Carroll et al., *Strengthening the Use of Science in Achieving the Goals of the Endangered Species Act: An Assessment by the Ecological Society of America*, 6 *ECOLOGICAL APPLICATIONS* 1, 10 (1996) (scientists calling for

effective, and thoughtful conservation. To protect endangered species, we either must attempt to re-create or revive ecosystems ourselves, an enormously expensive proposition, or protect the ecosystems in the first place. Why not use ecosystem protection as the focus of the Act to begin with?

A fourth criticism of the effectiveness of the ESA is that conservation efforts under the Act often occur far too late.²⁷⁰ Indeed, one study found that the median population for a species of vertebrate animals at the time of listing was 1075 individuals, and for plants at the time of listing it was 120 individuals.²⁷¹ Thus, by the time a species has been listed under the Act, its population is so low that recovery efforts may be unable to succeed, or will take extraordinary amounts of time and money to succeed. As a result, the ESA makes recovery and conservation efforts harder than they otherwise might be²⁷² by delaying intervention until the threshold of “endangered” or

the use of ecosystem-level planning in the application of the ESA); *Recovery Plans and the Endangered Species Act*, *supra* note 221, at 194 (calling for “more emphasis on multi-species and ecosystem-level recovery plans . . . as an interim step towards broader, ecosystem-level protection”); K. Shawn Smallwood et al., *Using the Best Scientific Data for Endangered Species Conservation*, 24 ENVTL. MGMT. 421, 425–27 (1999) (calling for systematic incorporation of ecosystem assessments into the implementation of the Act); Daniel J. Rohlf, *Six Biological Reasons Why the Endangered Species Act Doesn't Work—And What to Do About It*, 5 CONSERVATION BIOLOGY 273, 275 (1991) (arguing that ecosystem approaches should be applied in implementing the ESA, but are not); Brown, *supra* note 262, at 178–82 (criticizing ESA's single-species approach and highlighting the importance of keystone species in successful ecosystem protection); Spitzberg, *supra* note 259, at 205–08 (articulating problems with the species-based approach and proposing ecosystem-based alternatives); Smith et al., *supra* note 219, at 1069–74 (“The ESA would be even more effective if implemented with ecosystem conservation as a goal.”); Reed F. Noss, *Some Principles of Conservation Biology, As They Apply to Environmental Law*, 69 CHI.-KENT L. REV. 893, 904–07 (1994) (advocating ecosystem management while cautioning that it “requires some rules of its own”); Gibbons, *supra* note 255, at 1386 (reporting that a growing number of scientists think that the solution to the ESA's problems is protecting habitats, not species); Holly Doremus, *Patching the Ark: Improving Legal Protection of Biological Diversity*, 18 ECOLOGY L.Q. 265, 304–12 (1991) [hereinafter Doremus, *Patching the Ark*]; James Drozdowski, *Saving an Endangered Act: The Case for a Biodiversity Approach to ESA Conservation Efforts*, 45 CASE W. RES. L. REV. 553, 584–600 (1995) (arguing that conservation should concentrate on ecosystems and biodiversity as a whole); *Is Endangered Species Act in Danger?*, *supra* note 245, at 1258 (explaining the Clinton administration's approval of the ecosystem approach by supporting regional projects such as the Balcones Canyonlands Conservation Plan); Hugh DeForest Safford, *The Recovery Planning Blues*, 69 NORTHWEST SCI. 330, 331 (1995) (reporting that many critics argue that preservation of areas, instead of species, would be simpler and less expensive); Kunich, *supra* note 255, at 572–73 (advocating the ecosystem approach as part of effective ESA reauthorization).

²⁷⁰ Tim W. Clark et al., *Synthesis*, in *ENDANGERED SPECIES RECOVERY: FINDING THE LESSONS, IMPROVING THE PROCESS* 417, 424 (Tim W. Clark et al. eds., 1994).

²⁷¹ David S. Wilcove et al., *What Exactly is an Endangered Species? An Analysis of the U.S. Endangered Species List: 1985–1991*, 7 CONSERVATION BIOLOGY 87, 87 (1993).

²⁷² There is a strong case to be made, however, that it is not the text of the law that has led to withholding aid from species until the last minute, but the implementation of the Act by the Services that has led to this result. Whether because of funding constraints or political pressure, these commentators argue that the Services have illegally delayed listing species long after science and biology would dictate that the species are threatened or endangered. A GAO report explicitly found that political factors had contributed to delays in the listing of species. GEN. ACCOUNTING OFFICE, *ENDANGERED SPECIES: FACTORS ASSOCIATED WITH DELAYED LISTING*

“threatened” status has been reached.²⁷³ At that point, options have been foreclosed (by changes in land-use decisions, or falling population levels for the species) and expensive rescue efforts are the only possible solutions. Even if the populations of such species can be kept from falling any further, the encroachment of human development activities and the elimination of suitable habitat may mean that increasing the numbers or range of a species is impossible (at least given current economic and political constraints).

Finally, some commentators and environmental groups have argued that the Service’s implementation of the law has been too weak, and that by changing key definitions of terms the Service has removed the effectiveness of some important legal tools within the ESA. For example, many environmentalists argue that critical habitat designation could be an extremely effective tool in the enforcement of the Act. They argue that the ban on alteration or degradation of critical habitat would provide significantly greater protection to endangered species habitat from federal actions than the current section 9 take prohibition on the damage to habitat, which requires a showing of harm to individual listed animals.²⁷⁴ Environmentalists also argue that, in terms of judicial enforcement of the ESA through citizen suits against the federal government, the designation of critical habitat may be crucial to success for a lawsuit.²⁷⁵ However, the Service’s current interpretation of critical habitat means that, in many cases, the adverse modification standard under section 7 is redundant with the jeopardy standard because adverse modification is defined as habitat modification that would result in jeopardy to the species. Under that

DECISIONS 5 (1993); see also Smith et al., *supra* note 219, at 1046–47 (blaming delays in listing on “insufficient funding and political pressure”); Timothy Bechtold, *Listing the Bull Trout Under the Endangered Species Act: The Passive Aggressive Strategy of the United States Fish and Wildlife Service to Prevent Protecting Warranted Species*, 20 PUB. LAND & RESOURCES L. REV. 99, 123–28 (1999) (describing the numerous administrative delays in listing a fish species and the lawsuits that eventually forced listing of the species). Indeed, a number of species or subspecies have gone extinct while waiting to be listed under the Act. Gibbons, *supra* note 255, at 1386.

²⁷³ See, e.g., Kunich, *supra* note 255, at 550 (“[T]he ESA allows species to deteriorate to the brink of extinction before it begins to intervene. Decades or centuries of neglect and exploitation take a heavy, often irremediable toll on the species before the curative provisions of the Act take effect.”); *Is Endangered Species Act in Danger?*, *supra* note 245, at 1257; Doremus, *Patching the Ark*, *supra* note 269, at 316–18; Randall Cortez Wilson, *Triage and the Endangered Species Act*, in TRANSACTIONS OF THE SIXTIETH NORTH AMERICAN WILDLIFE AND NATURAL RESOURCES CONFERENCES 463, 464 (Kelly G. Wadsworth et al. eds., 1995).

²⁷⁴ See Jason M. Patlis, *Paying Tribute to Joseph Heller with the Endangered Species Act: When Critical Habitat Isn’t*, 20 STAN. ENVTL. L.J. 133, 200–05 (2001) [hereinafter Patlis, *Paying Tribute to Joseph Heller*] (arguing that the Service’s current narrow interpretation of critical habitat undermines judicial enforcement of the Act); McDonald, *supra* note 150, at 688–90 (arguing that a broader definition of critical habitat could provide additional protection to listed species).

²⁷⁵ Salzman, *supra* note 149, at 323–31 (arguing that litigation is far more successful by environmental groups when a proposed action threatens to adversely modify designated critical habitat). A statistical analysis of the relationship between the designation of critical habitat and the trend (stable, declining or improving) of the population of the listed species found that critical habitat designation had a marginal positive impact on recovery of species. Rachlinski, *supra* note 5, at 384.

interpretation, the value of designating critical habitat for mussel species might be negligible.²⁷⁶ The Service has used this narrow definition of critical habitat to argue that designating critical habitat would not be “prudent” for the vast majority of species because critical habitat would not add any protection for those species through section 7.²⁷⁷ Environmentalists respond that this construction of the Act is illegal,²⁷⁸ and that the problem with

²⁷⁶ Compare Interagency Cooperation—Endangered Species Act of 1973, as Amended, 51 Fed. Reg. 19,926, 19,958 (June 3, 1986) (defining the destruction or adverse modification of critical habitat as “a direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species”), with *id.* (defining “jeopardize the continued existence of” as “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”). See also *id.* at 19,934, (noting that the word “both” “was added by the proposed rule to emphasize that, except in exceptional circumstances, injury to recovery alone would not warrant the issuance of a ‘jeopardy’ biological opinion”); Final Listing Priority Guidance for Fiscal Years 1998 and 1999, 63 Fed. Reg. 25,502, 25,510 (May 8, 1998) (“[T]he Service has determined that in most cases little or no additional protection is gained by designating critical habitat for species already on the lists [T]he Service continues to believe that the designation of critical habitat provides little or no additional protection beyond the ‘jeopardy’ prohibition of section 7.”) (outlining that critical habitat designation is to receive the lowest priority in the Service’s listing activities); *id.* at 25,509 (“[C]ritical habitat designations (Tier 3 actions) during FY 1998 should not be expected.”); Patlis, *Paying Tribute to Joseph Heller*, *supra* note 274, at 168–69, 177 (noting that the Service’s definition essentially made the critical habitat provision redundant to the jeopardy provision); Shawn E. Smith, *How ‘Critical’ Is a Critical Habitat?: The United States Fish and Wildlife Service’s Duty Under the Endangered Species Act*, 8 DICK. J. ENVTL. L. & POL’Y 343, 379 (1999) (“The screening function that Section 7’s consultation process serves is not altered by the fact that a critical habitat is not designated.”); Houck, *Implementation*, *supra* note 150, at 298–301 (arguing that the Service has illegally defined critical habitat as essentially the same as jeopardy); Rohlf, *supra* note 269, at 278–79 (arguing that the Services have “made critical habitat designations essentially moot by reading out of the law Section 7’s protections for habitat sufficient to support recovered populations of listed species”); Weiner, *supra* note 150, at 43–45 (arguing that the reason critical habitat does not provide any benefit is because of the Service’s own regulations).

²⁷⁷ See “*Lasnigona decorata*” (Carolina Heelsplitter) Determined to be Endangered, 58 Fed. Reg. 34,926, 34,930 (June 30, 1993) (“Due to the highly precarious status of the Carolina Heelsplitter, any Federal action likely to adversely affect the species would trigger both [the critical habitat and no jeopardy requirements].”); Determination of Endangered Status for the Winged Mapleleaf Freshwater Mussel, 56 Fed. Reg. 28,345, 28,348 (June 20, 1991) (“Critical habitat designation would not provide additional protection over that afforded through the normal section 7 consultation procedures.”); see also *Conservation Council for Hawaii v. Babbitt*, 2 F. Supp. 2d 1280, 1282 (D. Haw. 1998) (describing the Service’s argument not to designate critical habitat because such designations would not increase protections for endangered or threatened species); Darin, *supra* note 150, at 227–28; Houck, *Implementation*, *supra* note 150, at 307; TYPES AND NUMBER OF IMPLEMENTING ACTIONS, *supra* note 149, at 28. Thus, from April 1996 to April 1998, the Service had not designated critical habitat for a single one of the 178 species added to the endangered species lists. Weiner, *supra* note 150, at 41. The Service has also argued that funding constraints have prevented it from designating critical habitat, and that because of critical habitat’s relatively low benefit, designation should be a low priority. Environmentalists have responded that the funding constraints have been created by the Service itself through requests to cap the funding for listing and critical habitat designation. See *id.* at 42–43.

²⁷⁸ Recent litigation may force the Service to take a much broader view of critical habitat, which in turn might allow for stronger protection of listed species against federal actions. See *Sierra Club v. United States Fish & Wildlife Serv.*, 245 F.3d 434, 444 (5th Cir. 2001) (holding that the Service’s regulations for critical habitat are unlawful where they do not take into account

critical habitat rests in the Service's definition of adverse modification of critical habitat as requiring a showing of harm both to survival and to recovery of the species. Arguably, a broader definition of adverse modification that included recovery would provide a much tougher critical habitat requirement under the ESA. A broader definition would have the potential to restrict far more federal actions, or to force the modification of those actions to provide much greater protection for listed species.²⁷⁹

The fight over critical habitat designation is part of a larger critique of the ESA by a few commentators, who argue that (at least under current interpretation of the ESA by the Service) the ESA effectively manages species to avoid extinction rather than to promote recovery.²⁸⁰ Thus, all of the legal tools in section 7 (the jeopardy standard and the adverse modification standard, as applied through the consultation process) only prevent federal action that leads to jeopardy, not federal action that retards recovery (at least as currently interpreted by the Service). Similarly, the application of the section 9 take standards to the HCP process by the Service have allowed permits to be granted for projects as long as they do not jeopardize the survival of the species, rather than to require permitted projects to provide a net recovery benefit for the species.²⁸¹ Thus, all of the pressure for recovering listed species is placed on an overburdened, underfunded recovery program rather than being built into the regulatory programs of sections 7 and 9.

providing for the recovery of listed species); see also Patlis, *Paying Tribute to Joseph Heller*, *supra* note 274, at 177-79 & nn.179-93 (discussing the "droves" of lawsuits by environmental groups that have forced the designation of critical habitat for listed species and forced the Service to reconsider its approach to critical habitat); Notice of Intent to Clarify the Role of Habitat in Endangered Species Conservation, 64 Fed. Reg. 31,871 (June 14, 1999) (requesting comments and suggestions from the public on how to reform and improve the critical habitat process); Determination of Endangered Status for the Scaleshell Mussel, 66 Fed. Reg. 51,322, 51,337-38 (Oct. 9, 2001) (stating that the Service has reconsidered its critical habitat policy in part because of recent case law).

²⁷⁹ But see Edward C. Beedy, *Ten Ways to Fix the Endangered Species Act*, ENDANGERED SPECIES UPDATE, Nov.-Dec. 1995, at 12-14 (arguing for the elimination of critical habitat designation because it is redundant, adds no new protections, has the potential to "restrict land uses and to reduce property values" on private property, and is costly to designate); Smith, *supra* note 276, at 345 (arguing that the courts should defer to the Service's decisions not to designate critical habitat).

²⁸⁰ See Federico Cheever, *The Road to Recovery: A New Way of Thinking About the Endangered Species Act*, 23 *ECOLOGY L.Q.* 1 (1996) (arguing that recovery is the key goal of the ESA, that the Service's current interpretations and applications of the law have placed the full burden of recovery on the recovery plan and implementation process, and calling for the Service to reevaluate and reinterpret the law to put more emphasis on recovery in the application of sections 9 and 7); Patlis, *Recovery, Conservation, and Survival*, *supra* note 137, at 114-15 (calling for a broader application of recovery implementation to include section 7 consultation).

²⁸¹ See, e.g., REBUILDING THE ARK, *supra* note 2, at 8-10 (describing how the ESA does not provide incentives to landowners to maintain population of endangered species over time); John Kostyack, *Reshaping Habitat Conservation Plans for Species Recovery: An Introduction to a Series of Articles on Habitat Conservation Plans*, 27 *ENVTL. L.* 755, 757 (1997) (noting that scientists and conservationists have criticized recent HCPs "for allowing substantial habitat destruction without appropriate consideration of species' long-term survival needs").

VII. LESSONS FROM THE CASE STUDY

Some of the common explanations for the failures of the ESA appear to be inapplicable to freshwater mussels. One could argue that there are too many listed mussel species chasing too little funding. However, given the extensive overlaps in range among many freshwater mussels (with some river drainages having over a dozen listed species), and the fact that many of the species face the same threats, prioritization among various mussel species appears to make little sense. Recovery efforts directed at one species in a watershed often have significant benefits for other species as well.²⁸²

Similarly, the lack of cooperation by private landowners is probably not nearly as important for endangered mussels as it has been for other species (such as red-cockaded woodpeckers). First, most endangered mussels are located on what is effectively public property, such as streams, lakes, and rivers.²⁸³ Second, the Service has been doing almost no section 9 enforcement for freshwater mussels, at least for upland development and land-use projects on private property that might affect waterways.²⁸⁴ Thus, the perverse incentives to eliminate freshwater mussels would not be as sharp for most landowners. Of course, there is a potential that landowners may fear future land-use restrictions because of the existence of mussels.²⁸⁵ Therefore, landowners may take active measures to eliminate mussels now (or at least not take active measures to improve habitat conditions for mussels).²⁸⁶ Given the difficulty of identifying and locating freshwater

²⁸² Cummings Interview, *supra* note 54. Of course, some might argue that resources should not be directed at mussel species at all, because they are less valuable economically or socially. However, that conclusion will not solve the problem of preventing the extinction of freshwater mussels.

²⁸³ The status of submerged lands as private property depends on state law. However, the strict regulation of the dredging and filling of waterways (both by the federal government and by states) means that in many cases waterways are already perceived more as public rather than private property.

²⁸⁴ Enforcement of upland development is a separate analytical issue from section 9 enforcement against individuals who directly take endangered mussels from the streambeds. Enforcement regarding taking mussels from the streambed would occur on public property (the waterway) and would not implicate the perverse incentives of land-use regulation that have been a focus of critiques.

²⁸⁵ Such concerns were expressed in comments submitted regarding proposed listings of mussel species in the 1990s. See, e.g., Final Rule to List the Ouachita Rock-Pocketbook, 56 Fed. Reg. 54,960, 54,953-54 (Oct. 23, 1991) (describing comments by landowners questioning whether "critical habitat was not being designated to avoid compensating landowners for loss of property value," expressing concern regarding social and economic impacts of listing, and asking whether the "Service would seize land along the Kiamichi River without due compensation to property owners"); Determination of Endangered Status for Five Freshwater Mussels and Threatened Status for Two Freshwater Mussels From the Eastern Gulf Slope Drainages of Alabama, Florida, and Georgia, 63 Fed. Reg. 12,664, 12,677-78 (Mar. 16, 1998) (listing comments expressing concern that "recovery plans would restrict land use practices and private property rights," that sections 7, 9, and 10 could affect private actions, and that listing would adversely affect agriculture and gravel mining in the area).

²⁸⁶ Certainly landowners have no incentive to undertake actions that address significant threats to freshwater mussels, such as removal or control of exotic species such as zebra

mussels (for non-experts at least), the possibility of active destruction by landowners seems to be a relatively low risk.²⁸⁷ None of the Service biologists interviewed believed that there was significant hostility toward freshwater mussels because of the potential for land-use regulation due to the listing of the species. Any hostility or reluctance to cooperate with the Service by landowners was attributed more to a general distrust of the federal government in rural areas.²⁸⁸

A. *Delayed Protection Harms Recovery*

The population of freshwater mussel species may have declined too far for any recovery efforts to succeed. A number of species are known only from a few isolated populations that are small, not reproducing, and continuing to decline for unknown reasons. Reviving such small populations, especially given the biological constraints discussed in Part II (including the low reproductive success rate of mussels, and their possible need for dense populations to reproduce) may be impossible. Similarly, even if extinction can be averted for some species, the elimination of most suitable habitat and the spread of competing exotic species might make full recovery (*i.e.*, delisting from the ESA) impossible. For example, as noted earlier, the majority—sometimes the vast majority—of habitat for freshwater mussels has been eliminated through the construction of dams, reservoirs, channels, and locks. There is nothing the ESA can do, at least in its current format, to reverse this adverse habitat modification. As a result, the habitat that is left to the mussel species is small, fragmented, and of reduced quality.

Thus, a number of mussel recovery plans, while setting recovery goals for delisting, note that full recovery for the species may not be possible because of the unsuitability of most historic habitats due to human

mussels, which are outside the scope of the Act and do not result from any current human actions. However, the lack of incentive is apparently not due to the ESA's perverse incentives (because there appears to be no threat of section 9 enforcement against private landowners), but rather because private landowners have no economic incentive to take action against exotic species in general and in this particular situation, where mussels have little economic value and are located on public property. Thus, the situation is different from the context of other species, such as the red-cockaded woodpecker, where landowners might undertake actions to help the listed species because those actions would also provide the landowners some economic benefits (such as following a certain timber rotation). In those situations, actions are not taken because of a fear of increased land regulation. *See generally* REBUILDING THE ARK, *supra* note 2, at 1, 7, 19 (noting that landowners' unwillingness to create, restore, or enhance habitat on their land stems from fear of new restrictions).

²⁸⁷ *See supra* text accompanying notes 146–53 (discussing the risk of vandalism in relation to the designation of critical habitat).

²⁸⁸ *See* Hartfield Interview, *supra* note 33; Tolin Interview, *supra* note 33; April 17 Biologist Interview, *supra* note 154. Some biologists did report individual incidents of hostility towards listed mussels or hostility in particular watersheds towards general government intrusion, and a reluctance to work with federal agencies. April 17 Biologist Interview, *supra* note 154; April 19 Biologist Interview, *supra* note 59. However, the biologists generally attributed these attitudes to general antipathy towards the government, rather than a fear that the existence and recovery of listed mussel species would lead to additional regulation of private land.

alteration.²⁸⁹ Recovery may be especially difficult for these species because of low reproductive success rates, low population growth rates, dependence on fish for dispersal of young to new habitats, and the long lifespan of mussels. One biologist stated that while recovery for populations of animals such as turkey and deer could be characterized as occurring in a matter of years, for mussels, recovery could require decades.²⁹⁰ Another biologist emphasized the difficulty of recovering species that have lost ninety-five percent of their habitat and ninety-five percent of their populations before recovery efforts have even begun.²⁹¹ Of thirty mussel species listed between October 1990 and February 2001 for which population estimates were provided in the listing notices in the Federal Register, the average number of populations per species was 7.5, and many of these populations were small, isolated, and showed no sign of reproduction.²⁹² Clearly, even today, by the

²⁸⁹ See, e.g., FANSHELL RECOVERY PLAN, *supra* note 226, at 6; PURPLE CAT'S PAW PEARLYMUSSEL RECOVERY PLAN, *supra* note 104, at 5; APPALACHIAN ELKTOE RECOVERY PLAN, *supra* note 104, at 7; CAROLINA HEELSPLITTER RECOVERY PLAN, *supra* note 12, at 6; CRACKING PEARLYMUSSEL RECOVERY PLAN, *supra* note 12, at 6.

²⁹⁰ See Koch Interview, *supra* note 54 (discussing threats to populations and recovery from agriculture, mining, pollution, and predation, as well as factors limiting the implementation of recovery plans such as lack of funding and concern for mussel species). Similarly, because of the long life-spans and low reproductive rates of mussels, it may be decades before we are truly aware of the scope of the threats to freshwater mussels, when aging mussel populations that are not being replaced by young mussels finally disappear. April 27 Biologist Interview, *supra* note 56.

²⁹¹ Boyer Interview, *supra* note 198.

²⁹² Estimates of the number of individuals for listed mussel species are generally not available, due to the difficulty of finding and identifying individual mussels. Thus, population estimates have generally been used to quantify the status of mussel species. Listing notices included the following: Determination of Threatened Status for the Inflated Heelsplitter, *Potamillus inflatus*, 55 Fed. Reg. 39,868 (Sept. 28, 1990); Appalachian Elktoe Determined to be an Endangered Species, 59 Fed. Reg. 60,324 (Nov. 23, 1994); Determination of Endangered Status for the Northern Riffleshell Mussel (*Epioblasma toriosa rangiana*) and the Clubshell Mussel (*Pleurobema clava*), 58 Fed. Reg. 5638 (Jan. 22, 1993); Endangered Status for Eight Freshwater Mussels and Threatened Status for Three Freshwater Mussels in the Mobile River Drainage, 58 Fed. Reg. 14,330 (Mar. 17, 1993); Determination of Endangered Status for the Winged Mapleleaf Freshwater Mussel, 56 Fed. Reg. 28,345 (June 20, 1991); "*Lasmigona decorata*" (Carolina Heelsplitter) Determined to be Endangered, 58 Fed. Reg. 34,296 (June 30, 1993); Determination to Reclassify the Louisiana Pearlshell (*Margaritifera hembeli*) from Endangered to Threatened, 58 Fed. Reg. 49,935 (Sept. 24, 1993); Determination of Endangered Status for the Cumberland Pigtoe Mussel, 56 Fed. Reg. 21,084 (May 7, 1991); Determination of Endangered Status for Five Freshwater Mussels and Threatened Status for Two Freshwater Mussels from the Eastern Gulf Slope Drainages of Alabama, Florida, and Georgia, 63 Fed. Reg. 12,664 (Mar. 16, 1998); Determination of Endangered Status for the Cumberland Elktoe, Oyster Mussel, Cumberlandian Combshell, Purple Bean, and Rough Rabbitsfoot, 62 Fed. Reg. 1647 (Jan. 10, 1997); and Final Rule to List the Ouachita Rock-Pocketbook (Mussel) as an Endangered Species, 56 Fed. Reg. 54,950 (Oct. 23, 1991). Two species did not have population estimates as part of the listing notice. An additional problem in this type of analysis is that the definition of "population" appeared to vary greatly among the various biologists who produced the listing notices. For example, some species had populations counted as entire river stretches where mussels were found, while for other species, each site location where mussels were found along a river stretch was considered to be a distinct population. For examples of populations that are not reproducing and were small and fragmented, see the discussion of the status for the mussel species in the Mobile River Drainage, 58 Fed. Reg. 14,330 (Mar. 17, 1993).

time of listing many mussel species are very much on the verge of extinction.

B. Legal Gaps in the ESA that Harm Aquatic Species

Freshwater mussels also appear to be victims of an unfortunate combination of significant gaps in the coverage and applicability of the ESA, gaps that are common in the context of the protection of aquatic species. For instance, the consultation process in section 7 has a very uncertain legal basis in the context of federal regulatory programs delegated to state agencies.²⁹³ Because the CWA is one of the major regulatory programs delegated to state agencies and is the primary (and perhaps only) federal mechanism to protect water quality, and because water quality is so important to the survival of freshwater mussels,²⁹⁴ this gap in the coverage of section 7 consultation may very well have significant impacts for the protection of freshwater mussels. Certainly, it is ironic that the permitting of point sources—in which water quality is directly compromised by direct discharges into the waterbodies—may be excluded entirely from the section 7 consultation process for mussels, while other actions with more indirect, and usually more temporary, impacts (such as bridge construction) are subject to significantly greater section 7 review.

However, an even greater gap in the coverage of the ESA is section 9. The near-complete absence of section 9 enforcement with respect to freshwater mussels is striking given the critical needs for protection that freshwater mussels have. Certainly, many of the private actions that could harm mussels have a federal “nexus” such that section 7 consultation would apply, and even if a landowner preferred the HCP exemption process from section 10²⁹⁵ over the section 7 consultation process, the landowner would be forced to take the section 7 option. Still, there are many private actions which might only be covered by section 9.

Thus, there are a wide range of private actions that most biologists agree have a significant impact on mussels through nonpoint runoff and erosion which are not being regulated under the ESA. Indeed, many biologists interviewed felt that nonpoint pollution was among the primary threats facing freshwater mussels (perhaps because it has been so unregulated to this point).²⁹⁶ Because nonpoint source activities do not require a federal permit, section 7 does not apply to them, making section 9 the sole and exclusive means for regulation under the ESA. Yet, there have been no section 9 enforcement actions against private landowners regarding freshwater mussels, nor an HCP granted to a landowner to avoid the threat of section 9.²⁹⁷

²⁹³ See *supra* Part V (discussing current application of the ESA to freshwater mussels).

²⁹⁴ See *supra* Part III.D (discussing the impacts of siltation, sewage effluent, nonpoint runoff, other pollution, and temperature alterations on mussel populations).

²⁹⁵ But see *supra* Part V.A.3 (discussing how project applicants apparently prefer the section 7 process because of its greater speed and ease of use).

²⁹⁶ See *supra* Part III.D.3 (discussing mussel mortality due to urban and agricultural runoff).

²⁹⁷ The lack of section 9 enforcement has implications beyond the lack of regulation of

One possible explanation for the lack of section 9 enforcement to address nonpoint pollution could be the lack of science regarding the harm nonpoint pollution causes. However, most biologists appeared to conclude that the science was fairly strong behind the idea that sediment, runoff, and pollution causes harm to freshwater mussels, even if the exact mechanisms were unknown.²⁹⁸ An important natural experiment in Tennessee's Duck River watershed undercuts the explanation that lack of scientific knowledge is what is preventing application of the Act. After the termination of the Columbia Dam project, the TVA owned substantial lands along the Duck River (intended to be flooded as part of the reservoir), which it has since treated as a preserve area. The preserve area has been one of the few documented instances where endangered mussel populations have significantly increased.²⁹⁹ The most obvious explanation is that the elimination of development, and intense agricultural and residential uses in the watershed, greatly reduced the impacts of nonpoint source harms to the Duck River, allowing for the recovery of mussel populations.

According to several Service biologists, an explanation for the lack of section 9 enforcement was the difficulty of proving legal causation because of the large numbers of landowners within a particular watershed, and because land-use activities of any one landowner could significantly affect the water quality of that river system. It is very difficult for the Service to show that any one individual landowner's actions is causing harm to mussel populations.³⁰⁰ The lack of causation makes enforcement difficult for environmental groups filing citizen suits, as well as for the government, because many ESA restrictions are triggered by a showing of harm to individuals of a listed species by private or federal action.³⁰¹ For example,

nonpoint source pollution. It also means that certain impacts of federal projects—particularly indirect impacts that are beyond the scope of a reasonable and prudent measure to address—go unmitigated or unminimized. See discussion *supra* Part V.A.3 (discussing section 7).

²⁹⁸ See Cummings Interview, *supra* note 54 (stating that nonpoint runoff is an important threat to mussels, but is secondary to threats from siltation); Bogan Interview, *supra* note 33 (observing that the lack of knowledge about runoff problems is beginning to be addressed); Watters Interview, *supra* note 54 (describing studies and circumstantial evidence of decline and extinction due to runoff). *But see* Hartfield Interview, *supra* note 33 (arguing that overall nonpoint agricultural impacts have declined in intensity over the years).

²⁹⁹ Bean, *supra* note 191, at 114–18.

³⁰⁰ On the other hand, in the Pacific Northwest the listing of salmon populations as endangered has caused sharp restrictions on land use in upland areas that impact waterways because of the threat of section 9 liability. Causation does not appear to have been a significant factor here. One possible explanation for the distinction could be the significantly different land-holding patterns in the Northwest, where large landowners often own all or most of a watershed, and therefore impacts on water quality can be connected to the actions of a particular landowner.

³⁰¹ The exact level of proof of causation required to maintain a section 9 taking claim is unclear. Courts and commentators have developed various standards. See, e.g., *Marbeled Murrelet v. Babbitt*, 83 F.3d 1060, 1066–68 (9th Cir. 1996) (rejecting defendant's claims that direct proof of harm to a particular animal by the defendant must be shown, and instead relying on indirect evidence as to the probability of harm to animals by defendant's actions); *Forest Conservation Council v. Rosboro Lumber Co.*, 50 F.3d 781, 787–88 (9th Cir. 1995) (similar holding); *American Bald Eagle v. Bhatti*, 9 F.3d 163, 165–66 (1st Cir. 1993) (requiring proof of "actual harm" to an individual animal from defendant's actions); *Palila v. Hawaii Dep't of Land*

without evidence that a particular logging act caused the siltation that caused mortality to individual mussels (as opposed to some other act of logging or agriculture in the watershed), a prosecution for a section 9 take would fail for lack of proof of causation. Similarly, a citizen suit to enforce section 7 prohibitions against a federal agency might also fail for lack of evidence of harm to a species (which is necessary for a "jeopardy" finding).

The take prohibition of section 9 of the ESA suffers the same causation problems that nuisance suits and other common law methods for addressing water pollution suffered before the CWA was passed.³⁰² The difficulty of proving causation in the context of water pollution is what led, in part, to the development of stringent, technology-based point source pollution controls under the CWA in the early 1970s.³⁰³

The gaps in coverage of sections 7 and 9 are exacerbated by the removal of recovery protections from both sections. As discussed earlier, the definition of critical habitat has essentially removed any requirement that section 7 consultation ensure that federal actions protect recovery. Instead, critical habitat requirements have become redundant with the jeopardy standard.³⁰⁴ The lack of critical habitat designation, and the effective definition of critical habitat as equivalent to jeopardy, make enforcement of section 7 more difficult. With a more expansive definition of critical habitat, and designated critical habitat, the Service or a private environmental group would only have to prove that runoff is degrading critical habitat rather than show that runoff is causing harm to individual mussels or jeopardizing the existence of the entire species. Such relaxed standards might make proof of causation significantly easier in court and enforcement of section 7 against at least the most blatant nonpoint harms

& Natural Resources, 471 F. Supp. 985, 996-98 (D. Haw. 1979), *aff'd*, 639 F.2d 495 (9th Cir. 1981) (relying on expert testimony as to the probability of harm to individual animals from defendant's actions); Steven P. Quarles et al., *Sweet Home and the Narrowing of Wildlife "Take" Under Section 9 for the Endangered Species Act*, 26 *Env'tl. L. Rep.* (Env'tl. L. Inst.) 10,003, 10,007 (1996) (arguing that direct proof of harm to a specific animal is required, including production of a particular dead or injured individual, and proof that the defendant caused the harm to that animal); Tara L. Mueller, *Babbitt v. Sweet Home Chapter of Communities: When is Habitat Modification a Take?*, 3 *HASTINGS W.-NW. J. ENVTL. L. & POL'Y* 333, 348-50 (1996) (arguing that plaintiffs should be able to prove a taking through indirect evidence).

³⁰² See, e.g., *Missouri v. Illinois*, 200 U.S. 496, 516-17 (1906) (rejecting Missouri's claim that dumping of sewage by Chicago into river upstream from St. Louis was an actionable nuisance because of lack of proof of causation); *Stubbs v. City of Rochester*, 124 N.E. 137, 148 (N.Y. 1919) (rejecting claim of typhoid victim against city water supplier because of lack of proof of causation); see also JONATHAN HARR, *A CIVIL ACTION* 291-401 (1995) (describing the difficulty of proving causation of leukemia by toxic chemical contamination of groundwater supply); Michael C. Blumm, *The Fallacies of Free Market Environmentalism*, 15 *HARV. J.L. & PUB. POL'Y* 371, 386-87 (1992) (noting the "pervasive difficulty of proving causation when multiple sources or low level toxic exposures are involved").

³⁰³ See ROBERT V. PERCIVAL ET AL., *ENVIRONMENTAL REGULATION: LAW, SCIENCE AND POLICY* 639 (3d ed. 2000) ("Perhaps the predominant influence on the law was the universal recognition that basing compliance and enforcement efforts on a case-by-case judgment of a particular facility's impacts on ambient water quality is both scientifically and administratively difficult." (quoting COUNCIL ON ENVIRONMENTAL QUALITY, *ENVIRONMENTAL QUALITY - 1973*, at 171 (1973)).

³⁰⁴ See discussion *supra* Part VI.

feasible.

The Service's cooperative efforts are, in large part, an attempt to fill the void in the ESA with respect to protection of freshwater mussels from nonpoint pollution. Cooperative efforts can have a significant effect; however, these efforts also face a very substantial (perhaps insurmountable) problem. One hold-out landowner in a watershed can refuse to cooperate, decide to undertake legal actions that substantially degrade the river system, and undo all the good work of the cooperative efforts below that property.³⁰⁵ The collective action problem in the context of this resource may mean that cooperative efforts, if not entirely doomed, may be in large part ineffective.

The above analysis appears to support the criticism of the Act as too species-oriented and not focused enough on the protection of entire aquatic ecosystems. Certainly, a provision of the ESA that allowed the Service to protect the water and habitat quality of entire stream ecosystems would probably provide the authority to regulate (or provide positive incentives to reduce) nonpoint pollution. But this is not necessarily a flaw of the species-orientation of the ESA. It is very clear that freshwater mussel species depend on healthy stream ecosystems for their survival; therefore, protection of the most sensitive listed species will require protection of all the listed species (and most likely all of the unlisted species) through protection of the ecosystem. Thus, the problem again comes down to gaps in the ESA's enforcement and legal tools. For instance, if critical habitat was interpreted to require protection of habitat necessary for recovery, then protection of ecosystems might follow simply because providing for the recovery of these species would require protection of the ecosystem.

C. Enforcement and Funding Biases Hurting Mussels

Even if the structural and implementation problems of the ESA identified above were addressed, the safety of mussels would not be entirely ensured. The Service's failure to implement recovery plans for freshwater mussels, and the inadequate funding for mussel research and management both indicate that another factor is at work, because neither of these issues depends on the ESA's inadequate regulatory tools. Even the lack of section 9 enforcement with respect to mussels may not be due entirely to the legal issues discussed above—the similarities between actions that have been taken to protect listed Pacific salmon from nonpoint runoff impacts,³⁰⁶ and

³⁰⁵ Sanders Interview, *supra* note 32.

³⁰⁶ A number of HCPs have been developed for Pacific salmon in the Northwest, implying that private and state landowners do feel there is a risk. See, e.g., Press Release, Dep't of the Interior, Interior Secretary to Celebrate Unique Habitat Conservation Agreement with Simpson Timber on Olympic Peninsula (Oct. 11, 2000), available at 2000 WL 1507897 (announcing an HCP agreement with a timber company that "will protect about 51 species of salmon, native fish and wildlife species"); *Water Agency Seeks Protection from Environmental Prosecutions*, ENV'T NEWS SERV., Jan. 17, 2000, available at 2000 WL 7838009 (announcing a draft HCP for timber management and water withdrawal by Tacoma Water Department which will cover, among other species, trout and chinook salmon); *Plum Creek Applies for Permit to Kill Fish*, ENV'T NEWS SERV., Jan. 11, 2000, available at 2000 WL 7837926 (announcing an HCP application by

actions that need to be taken to protect freshwater mussels from similar impacts is striking. One likely explanation for at least some of the ESA's shortfalls with respect to freshwater mussels is that Congress and the Service have not made mussels a priority in the Act's implementation, and therefore, mussels have received insufficient attention and resources.

The Service has, in fact, adopted a system to determine which species should receive priority for limited funding for 1) listing, 2) delisting, and 3) recovery planning and implementation.³⁰⁷ For listing, the system provides highest priority to species facing high-level threats to their existence; priority is next given to species facing imminent threats; and the last priority level uses taxonomy, elevating species that are unique in their genus ("monotypic genus" species) over other species, and species are elevated over subspecies.³⁰⁸ For recovery, the system provides highest priority to species facing high threats; next to be considered is the potential for species recovery (species having high recovery potential are given preference); then taxonomy is considered (as in the listing priority guidelines); the final tiebreaker is whether that species is in conflict with construction or other development projects, or other forms of economic activity—those in conflict are higher priority.³⁰⁹ The system does not explicitly consider whether a species is a "higher or lower life form" (i.e., vertebrate or invertebrate, plant or animal, mammal or reptile). The Service originally considered such factors in its first priority guidelines system (adopted in 1980), but rejected them after Congress indicated in the 1982 amendments that such factors were impermissible.³¹⁰

The question is whether the Service's priority system is reflected in the Service's actual implementation of the Act. On the one hand, the priority system can be extremely important for providing or denying protection, especially when it appears the Service does not want to protect a species and can use the priority system as a legally defensible rationale for withholding such protection.³¹¹

Plum Creek for timber management actions for its lands in the Northwest for bull trout and salmon).

³⁰⁷ Endangered and Threatened Species Listing and Recovery Priority Guidelines, 48 Fed. Reg. 43,098, 43,098 (Sept. 21, 1983).

³⁰⁸ *Id.* at 43,103.

³⁰⁹ *Id.* at 43,104.

³¹⁰ *Id.* at 43,102. These congressional instructions were reinforced in the 1988 amendments, which explicitly prohibited giving preference to different taxonomic classifications. 16 U.S.C. § 1533(f)(1)(A) (2000) (requiring the agencies to "give priority to those endangered species or threatened species, without regard to taxonomic classification, that are most likely to benefit from such plans, particularly those species that are, or may be, in conflict with construction or other development projects or other forms of economic activity"). However, the Service's prioritization of monotypic genera may lead to a taxonomic bias for vertebrates over invertebrates because vertebrates tend to have more monotypic genera than invertebrates, perhaps because of a bias in scientific interest and studies. Dennis D. Murphy, *Invertebrate Conservation*, in *BALANCING ON THE BRINK OF EXTINCTION*, *supra* note 211, at 181, 185–87.

³¹¹ See Bechtold, *supra* note 272, at 114–21 (describing how the Service used a priority ranking of 9 to justify not listing the bull trout, and defending that ranking in court, despite opinions of the Service's own experts. The service then upgraded the ranking to 3 based on higher levels of threat, and then downgraded again to 9 just before another court hearing on the

On the other hand, evidence indicates that the Service does not follow the priority system for freshwater mussels. As noted in Part V.B.3, for Fiscal Year 1993 alone, the average expenditure per mussel species was \$71,342, the average per fish species was \$976,907, and the average per bird species was \$904,727. Yet the priority rankings for the three taxa in 1996 were statistically the same: birds had an average priority score of 5.74, fish an average priority score of 5.41, and mussels an average priority score of 5.32.³¹² While differences in recovery implementation and law enforcement are far more difficult to quantify, the data discussed in Part V certainly indicate that, historically, mussels have not received the strongest recovery implementation or enforcement efforts.

A number of commentators have also examined whether the Service's implementation of the Act matches its priority system. These commentators have primarily examined the expenditure information provided by the Service through numerous reports, and compared that data with the Service's priority system and with other possible explanations for discrepancies among species. These studies have also found biases based on the nature of species: body size is positively correlated with Service expenditures;³¹³ mammals and birds tend to receive higher levels of funding;³¹⁴ the longer the species is present on the list, the more funding it might receive;³¹⁵ the taxonomic factors purportedly given priority appear to have little impact;³¹⁶ rarity of the species might be negatively correlated with additional funding for the species;³¹⁷ and, more than any other factor in the priority system, greater weight is given to whether a species is involved in conflict with development.³¹⁸ Indeed, two comparisons between the Service's priority ranking system and expenditures in 1990³¹⁹ found no correlation between priority and expenditures.³²⁰ According to one study, priority 1 species received \$100,000 less per species than priority 6 species,³²¹ and \$53,200 was spent on priority 14 species compared to \$5,500

listing of the species).

³¹² REPORT TO CONGRESS ON THE RECOVERY PROGRAM, *supra* note 228, at A1 (source for the priority score rankings). The lower the number, the higher the priority ranking is. Two-tailed T-tests, with null hypothesis of no difference, found no statistical difference (p -value > .3) between the average scores of mussels and birds, and between mussels and fish.

³¹³ Andrew Metrick & Martin L. Weitzman, *Patterns of Behavior in Endangered Species Preservation*, 72 LAND ECONOMICS 1, 11 (1996). Metrick and Weitzman restricted their analysis to vertebrate species listed under the Act and used expenditure data through Fiscal Year 1992. *Id.*

³¹⁴ *Id.*; Benjamin M. Simon et al., *Allocating Scarce Resources for Endangered Species Recovery*, 14 J. POL'Y ANALYSIS & MGMT. 415, 429 (1995).

³¹⁵ Simon et al., *supra* note 314, at 429.

³¹⁶ Metrick & Weitzman, *supra* note 313, at 11; Simon et al., *supra* note 314, at 425-26.

³¹⁷ Metrick & Weitzman, *supra* note 313, at 11.

³¹⁸ *Id.* at 13-14; Simon et al., *supra* note 314, at 426.

³¹⁹ One of these studies examined only the Service's direct species-specific expenditures on recovery, as opposed to broader expenditures by all government agencies. Simon et al., *supra* note 314, at 420. The other study examined all government expenditures. *The Butterfly Problem*, *supra* note 255, at 59. The results are essentially the same either way.

³²⁰ *The Butterfly Problem*, *supra* note 255, at 59; Simon et al., *supra* note 314, at 420-24.

³²¹ Under the Service's current priority system, higher priority numbers translate into lower priority. Thus, priority 1 species receive the highest priority, and priority 18 species receive the

on priority 4 species.³²² The same study reported that more than half of government expenditures on endangered species went to eleven species.³²³ The other study on 1990 expenditures found that fifty species received 85.5 percent of all Service recovery funding, while 229 species received none at all.³²⁴

Analysis of the listing process by scholars has also shown biases not reflected in the Service's official guidance. One pair of scholars found that larger mammals, birds, reptiles, monotypic genera, and rare species were favored by the listing process (*i.e.*, listed with higher probability).³²⁵ Another researcher found that taxonomic status had little effect on the duration of listing delays for a subset of species examined, and that instead, public comments, number of petitions, and the "pro-environment" or "pro-land use" leanings of important congressional subcommittee members with the species in their constituencies were significant factors in determining delay.³²⁶ Two separate studies have found that at least some types of "higher" life forms consistently have larger populations when they are listed.³²⁷ Another study that combined analyses of listing and recovery processes found a consistent bias toward animals over plants in the listing and recovery planning process and toward vertebrates in the listing process.³²⁸

With respect to the implementation of the HCP process, one study

lowest.

³²² *The Butterfly Problem*, *supra* note 255, at 59.

³²³ *Id.*

³²⁴ Simon et al., *supra* note 314, at 421. A GAO report from 1988 found similar results from expenditures in the 1980s—12 species received nearly half of available recovery funds from fiscal years 1982 through 1985. MANAGEMENT IMPROVEMENTS, *supra* note 251, at 32.

³²⁵ Metrick & Weitzman, *supra* note 313, at 7-8.

³²⁶ Amy Whritenour Ando, *Waiting to Be Protected Under the Endangered Species Act: The Political Economy of Regulatory Delay*, 42 J.L. & ECON. 29, 44-52 (1999). Ando's study is empirically different from the Metrick and Weitzman study. Ando only studied correlation between factors and delay for species already petitioned for listing or on the Service's "candidate" list (species the Service is itself considering for listing); Metrick and Weitzman studied all species, and selected species at random to determine whether there was a correlation between the probability of listing and certain factors. *Id.* at 34. As Ando notes, Metrick and Weitzman's analysis "does not separate the contribution of the regulatory process from that of the scientific community to the observed patterns in listings; a species may not be on the list either because the agency is dragging its heels over its addition or because scientists have not gathered enough information about the species to support a case for its listing." *Id.* As discussed below, the reason for a bias against mussels in the process may be either because of a lack of scientific knowledge (because scientists are biased against studying mussels) or because of political pressure (because politicians and society as a whole are biased against protecting mussels).

³²⁷ See Andrea Easter-Pilcher, *Implementing the Endangered Species Act*, 46 BIOSCIENCE 355, 358 (May 1996) (finding that threatened mammals are listed when they have a median number of 13,718, while threatened birds, reptiles, and fish are listed with median numbers of 1921, 2525, and 450, respectively); Wilcove et al., *supra* note 271, at 90-91 (finding that median number for vertebrate species when listed as endangered was 1075 and for invertebrates was 999, with no statistically significant difference, and finding that listed plants were listed with median populations of 119.5 versus 999 for animals, with a statistically significant difference).

³²⁸ *Recovery Plans and the Endangered Species Act*, *supra* note 221, at 189-90.

found that there is a strong bias among the taxonomic groups covered by HCPs, with mammals, birds, amphibians, and reptiles overrepresented, and fish and invertebrates underrepresented.³²⁹ In fact, the study found that as of 1997, no HCPs covered fish species.³³⁰

Thus, it is clear that the priority system of the Service is not determining which species receive the most funding, the most enforcement efforts, or the greatest benefits of the ESA. Indeed, it appears that whether a species is an animal or a plant, or a vertebrate or an invertebrate, is also a significant factor in determining how funding and other resources are allocated in the application of the ESA.

The taxonomic bias in the system has a number of potential explanations. One is that there is simply less accumulated information about "lower level" life forms. For example, the lack of information about freshwater mussels contrasts with the higher levels of information available for many bird and mammal species.³³¹ A second possibility is that "lower level" life forms are faced with less severe threats than "higher level" life forms and, therefore, require less protection by the Service through enforcement and recovery processes. However, the analysis above for freshwater mussels should (at least for that taxonomic group) refute this argument, as have broader analyses across taxonomic groups.³³²

A third, and the most obvious possibility, is that "lower level" life forms (as their common name implies) are less socially valued by humans than "higher level" forms for a variety of economic, aesthetic, and cultural reasons. Social science surveys document that the general public has significantly higher negative attitudes towards invertebrates than towards vertebrates,³³³ that some invertebrates (particularly spiders, cockroaches,

³²⁹ Christopher R. Pyke et al., *Strange Bedfellows: Observations on the Current Relationship Between Recovery Plans and Habitat Conservation Planning*, ENDANGERED SPECIES UPDATE, Nov.-Dec. 1998, at 97, 99 fig.2, 101.

³³⁰ *Id.* at 99 fig.2. However, since 1997 there have been a number of HCPs proposed and developed for salmon and trout species in the Pacific Northwest in order to allow timber management and harvest activities to continue. See *supra* note 306. These statistical analyses parallel more anecdotal critiques of the unevenness of the Service's priority system. For instance, throughout the 1970s the Service had serious difficulties developing, and sticking with, one priority system, and yet despite the changes in that ranking system, it continued to spend enormous amounts on the recovery of a subspecies of bird in Florida, which moved from middle to high to low to high again on the priority system over the course of a number years. *The Butterfly Problem*, *supra* note 255, at 56-59. The subspecies, the dusky seaside sparrow, went extinct in the 1980s, despite the fact that millions of dollars were spent on habitat acquisition. *Id.*; see also Faith Campbell, *Endangered Plant Species Shortchanged: Increased Funding Needed*, ENDANGERED SPECIES UPDATE, Nov.-Dec. 1991, at 6 (arguing that plant recovery is underfunded by the Service, with plant species making up two-thirds of the listed species but receiving only 8% of recovery funding).

³³¹ See *Recovery Plans and the Endangered Species Act*, *supra* note 221, at 184-86 (discussing the relative difficulties of collecting data on different species and noting a general paucity of data for all rare species).

³³² See Foin et al., *supra* note 255, at 182-83 (finding that there was no clear division between plants and animals or between invertebrates and vertebrates in the types and severity of threats faced by threatened and endangered species).

³³³ See Stephen R. Kellert, *Values and Perceptions of Invertebrates*, 7 CONSERVATION BIOLOGY 845, 850-51 (1993) [hereinafter Kellert, *Values and Perceptions of Invertebrates*] (reporting that

and flies, among others) are seen in an overwhelmingly negative light by the public,³³⁴ that public knowledge about invertebrates is very limited,³³⁵ and that the public is much less likely to support significant expenditures of money for the conservation of most invertebrates (with the exception of some charismatic groups such as butterflies).³³⁶ These attitudes toward invertebrates in general must color public perceptions of mussels.

Such prioritization among taxonomic groups is not necessarily due solely to conscious decisions within the Service to provide more funding to vertebrates as opposed to invertebrates. Congressional earmarking of recovery funds for particular species, particularly popular species, for example, could explain a significant portion of the expenditure variations among species.³³⁷

Litigation pressure from environmental groups could also play a substantial role in the creation of a taxonomic bias against freshwater mussels. The ESA citizen suit provision provides a powerful tool for non-governmental organizations to ensure compliance with the law and to force the Service to undertake actions through court order, as opposed to administrative discretion. Service biologists have consistently stated that their agendas and resources are predominantly determined by litigation, rather than internal political or policy decisions.³³⁸ It also appears that freshwater mussels are not a popular cause for environmental groups to pursue, because such lawsuits are rare.³³⁹ The only lawsuit that attempted to

"feelings of fear, dislike, and indifference toward invertebrates were the most frequently encountered views of invertebrates among the general public").

³³⁴ See STEPHEN R. KELLERT, *THE VALUE OF LIFE: BIOLOGICAL DIVERSITY AND HUMAN SOCIETY* 124 (1996) [hereinafter *THE VALUE OF LIFE*] ("Most in our study expressed dislike of bugs, beetles, ants, crabs, spiders, ticks, and cockroaches; a strong aversion to insects in the home; extreme dislike of biting and stinging insects; a desire to eliminate mosquitoes, cockroaches, spiders, fleas, and moths altogether.").

³³⁵ See Kellert, *Values and Perceptions of Invertebrates*, *supra* note 333, at 849-50 (reporting that only 27% of respondents correctly knew that an octopus is not a type of fish, and that only 28% of respondents correctly knew that insects do not maintain a constant body temperature, unlike birds); see also *THE VALUE OF LIFE*, *supra* note 334, at 123-24 (reporting similar results).

³³⁶ See Stephen R. Kellert, *Social and Perceptual Factors in Endangered Species Management*, 49 *J. WILDLIFE MGMT.* 528, 530-31 (1985) [hereinafter Kellert, *Social and Perceptual Factors*] (reporting that respondents would choose to modify an energy project to protect a mountain lion, a fish species, a crocodile species, a bird species, or a butterfly species, but not for a spider species, a plant, or a snake species, with the lowest score being for the spider); *THE VALUE OF LIFE*, *supra* note 334, at 124 ("Few supported making significant expenditures or economic sacrifices on behalf of protecting endangered invertebrates.").

³³⁷ See Patlis, *Recovery, Conservation, and Survival*, *supra* note 137, at 79 (noting that Congress earmarks portions of recovery plan appropriations for particular species). However, one empirical study of the role of earmarking found that "accounting for congressional add-ons" did not change the study's finding of bias by the Service in its implementation of the Act. Simon et al., *supra* note 314, at 432.

³³⁸ Boyer Interview, *supra* note 198; April 17 Biologist Interview, *supra* note 154; Tolin Interview, *supra* note 33; April 19 Biologist Interview, *supra* note 59.

³³⁹ A Westlaw search of reported federal court cases with "endangered" in the same sentence as "mussels" produced no cases under the Endangered Species Act seeking listing, designation of critical habitat, or a finding of a section 9 take against a private actor. One case did involve a lawsuit seeking an injunction against logging in a National Forest, in which some

force recovery, listing, or other protective action by the Service for freshwater mussels was filed within the past couple of years by the Southern Appalachian Biodiversity Project. The lawsuit, which sought the designation of critical habitat for the Appalachian Elktoe and the Carolina Heelsplitter (as well as two other species), was settled by the Service and has led to the proposed designation of critical habitat for the Elktoe.³⁴⁰ Apparently, environmental groups—perhaps responding to external political pressures, or to the preferences of their own membership³⁴¹—have not focused on the protection of freshwater mussels. Therefore, the ESA's strongest enforcement and implementation tool, litigation, has not benefitted freshwater mussels.

There may also be explanations for the taxonomic bias that are internal to the Service. Many biologists and employees of federal and state wildlife agencies were trained in schools that provided a significant emphasis on traditional game and fish species, as opposed to non-game species such as mussels.³⁴² As a result, there may be a (subconscious) tilt in the interest, effort, and focus of the employees of agencies such as the Service away from species such as freshwater mussels.

of the claims were related to an alleged failure to consult by the Forest Service under the ESA, and in which some of the species involved were endangered mussels. *Kentucky Heartwood, Inc. v. Worthington*, 20 F. Supp. 2d 1076, 1081–82 (E.D. Ky. 1998). Another lawsuit against the United States Forest Service alleged violations of the National Forest Management Act because the Forest Service had failed to properly survey for, monitor, and protect sensitive species, including freshwater mussels, before undertaking logging actions. *Sierra Club v. Martin*, 71 F. Supp. 2d 1268, 1313 (N.D. Ga. 1996); *Sierra Club v. Martin*, 168 F.3d 1, 3 (11th Cir. 1999). Six suits involved lawsuits over alleged failure to comply with NEPA, where one of the environmental impacts allegedly overlooked was harm to freshwater mussels. *Hughes River Watershed Conservancy v. Johnson*, 165 F.3d 283 (4th Cir. 1999) (challenging compliance with NEPA in connection with a reservoir project, alleging the reservoir might increase the potential for zebra mussel invasions); *Hughes River Watershed Conservancy v. Glickman*, 81 F.3d 437 (4th Cir. 1996) (same); *River Road Alliance, Inc. v. Corps of Eng'rs*, 764 F.2d 445 (7th Cir. 1985) (alleging lack of compliance with NEPA in connection with permitting of a barge mooring facility); *Sierra Club v. United States Army Corps of Eng'rs*, 771 F.2d 409 (8th Cir. 1985) (same); *Hoosier Envtl. Council v. United States Army Corps of Eng'rs*, 105 F. Supp. 2d 953 (S.D. Ind. 2000) (same); *Wade v. Lewis*, 561 F. Supp. 913 (N.D. Ill. 1983) (same, in relation to construction of a bridge). One case involved a challenge by a property rights organization to the listing of a number of mussel species, a listing which had blocked the completion of the Columbia Dam. *Pac. Legal Found. v. Andrus*, 9 Envtl. L. Rep. (Envtl. L. Inst.) 20,413 (M.D. Tenn., May 24, 1979), *aff'd*, 657 F.2d 829 (6th Cir. 1981).

³⁴⁰ Telephone Interview with Marty Bergoffen, Attorney, Southern Appalachian Biodiversity Project (Apr. 19, 2001) [hereinafter Bergoffen Interview]. A notice of intent to sue has also been filed for the designation of critical habitat for five mussel species in the Upper Clinch River watershed, and for a number of mussel species in the Coosa River watershed in Alabama. April 19 Biologist Interview, *supra* note 59. Both of these interviewees confirmed that these lawsuits were, to their knowledge, the first ever filed solely to force the Service to take action with respect to freshwater mussels.

³⁴¹ A study of environmental groups found a much higher concentration of groups with a focus on particular taxonomic groups among vertebrate species, as opposed to invertebrates (especially molluscs and insects). Brian Czech et al., *Social Construction, Political Power and the Allocation of Benefits to Endangered Species*, 12 CONSERVATION BIOLOGY 1103, 1103 (1998).

³⁴² Strayer Interview, *supra* note 92; Hartfield Interview, *supra* note 33; Boyer Interview, *supra* note 198.

Finally, the Service also may be consciously directing efforts towards the recovery of species that are perceived to be politically popular, charismatic megafauna. For example, in responding to a GAO report in 1988 that identified extremely high concentrations of recovery funding on a few popular species, the Service identified two causes: congressional earmarking, and "the need to achieve a positive public perception of the program sometimes drives the agency to devote extra attention to species with high 'public appeal.'"³⁴³

VIII. CONCLUSION

One might conclude from this case study that the ESA has completely failed freshwater mussels. However, all of the biologists interviewed sharply contested this assessment. Their perception was that, were it not for the ESA, there would have been absolutely no public, political, or legal support for the conservation of freshwater mussels. The listing of freshwater mussels has brought much needed attention to their conservation, increased the number of researchers and managers, and according to these biologists, has probably saved most of the listed species from certain extinction.³⁴⁴

Although the ESA has not been able to bring about the recovery of these species, it is important to remember that many of these species have only seen serious recovery efforts in the past ten to twenty years; meanwhile, their decline had been progressing for decades before the ESA was enacted. To ask the ESA to show significant progress toward recovery in such a short time period may be asking too much.

Beyond showing how the ESA has failed or succeeded with respect to freshwater mussels, this case study also reveals the Act's broader success and failure, its potential, and possible areas for reform and improvement. Mussels, as the most endangered and vulnerable taxonomic group covered by the ESA, perhaps best show the underlying strengths and weaknesses of the Act. Specifically, the case study shows three main issues in the implementation of the ESA with respect to the conservation and recovery of endangered species. First, it shows the difficulty of recovering species which have substantially declined and have lost much of their habitat. Second, it shows that there are substantial gaps in the structure, administrative interpretation, and application of the ESA with respect to aquatic ecosystems and species. Third, it shows that there are significant and consistent biases in the application of the Act against a large uncharismatic group of invertebrate species.

The first conclusion is a warning that the ESA should become more focused on protecting species earlier, thus supporting critics who argue that

³⁴³ MANAGEMENT IMPROVEMENTS, *supra* note 251, at 33. The Report noted that in 1987, appropriations committees required the Service to use about 11% of recovery funds for eight species. *Id.*

³⁴⁴ Koch Interview, *supra* note 54 ("I think the most success that the ESA has had is to just bring that whole faunal component to the awareness of people, of academia, of scientists. Twenty years ago, you could have fit everybody interested in mussels in my office.").

the Act is a “deathbed” statute. But this conclusion is qualified by the fact that most (perhaps all) of the freshwater mussels that are listed were already well on their way to extinction before the ESA was passed; accordingly, to blame the structure of the ESA for their dire straits before listing seems misplaced. As Part III of the paper indicated, the threats to freshwater mussels have been accumulating for decades, since the nineteenth century. Even when listing for these species did not occur until well after the passage of the ESA, that predominantly appears to be due to a lack of knowledge about the species rather than because the species was better off in the 1980s or late 1970s.³⁴⁵ The large accumulation of species listed since the passage of the ESA is the heritage of the “extinction debt” that the United States accumulated through decades of human development and habitat alteration prior to the passage of the ESA; thus, it is not predominantly the result of a flawed ESA.³⁴⁶ For all of these reasons, recovery data should be looked at with great suspicion and caution when it is being used to evaluate the success or failure of the ESA.³⁴⁷

The second conclusion of this Comment indicates that an act that might have been predominantly written with terrestrial and marine organisms in mind may have serious flaws when applied to the very different biological, social, and management circumstances of freshwater aquatic species. The importance of aquatic pollution—particularly diffuse nonpoint source pollution—to the protection of freshwater mussels has highlighted an important gap in the Act, where private actions are not clearly harmful enough to be covered by section 9, yet are outside the scope of section 7. The model of identifying individual actors who have caused particular harms to particular animals may (or may not) work in the context of terrestrial species, but in the context of aquatic species it appears to be useless in preventing nonpoint pollution harms. This problem is exacerbated by a narrow reading of important provisions of section 7 by the Service, particularly critical habitat protection. The importance of aquatic pollution as a major, uncontrolled, and unregulated source of harm to freshwater mussel species also underlines the importance of the interaction of the CWA and the ESA for the protection of aquatic species in general.

Congress could amend the ESA to incorporate technology-based, command-and-control standards for private actions that harm critical habitat (similar to those in the CWA), thereby obviating the need to prove causation under section 9. But such drastic action does not really seem to be necessary. Three potential changes to the interpretation of both the ESA and the CWA by EPA and the Service may address the gap of coverage for water quality harm under the ESA.

One solution would be an aggressive effort by EPA and the Service to

³⁴⁵ April 19 Biologist Interview, *supra* note 59.

³⁴⁶ See Doremus, *Delisting Endangered Species*, *supra* note 249, at 10,446–49 (stating that the combination of small population demographics, lack of effective regulatory protection, habitat destruction, and exotic species means that most listed species may remain on the ESA list for the foreseeable future).

³⁴⁷ *Id.*

incorporate endangered species concerns into the point-source permitting and standard-setting process of the CWA. Setting tough water quality standards that protect listed species from harm would put pressure on point source generators to reduce their discharges to improve the ambient water quality of rivers and streams. Either the point source generators would make the necessary investments to reduce discharges or, more likely, undertake actions to reduce nonpoint source pollution (possibly through payments to landowners to implement best management practices or the purchase of buffer conservation easements in riparian areas). The benefit over the voluntary, cooperative system now in place to address nonpoint pollution would be that one party would ultimately be responsible for ensuring that the nonpoint control measures succeed, and are not undermined by holdouts. Under the current system, no party is responsible. The current efforts by EPA and the Service to ensure, through EPA's triennial review of state water quality standards, that state water standards protect listed species could be the beginning of just such a reform of the CWA and the ESA.³⁴⁸

A second possible solution, as noted earlier, would be for the Service to revise its definition of critical habitat to include habitat that is necessary for the recovery (not just the survival) of listed species, and its definition of the destruction or alteration of critical habitat to include actions that prevent recovery. This broader definition of critical habitat would allow for the designation as protected critical habitat waterbodies where the species does not currently exist, but which are necessary for the eventual recovery of the species (through natural expansion of the population or translocation). A broader definition of alteration or destruction of critical habitat would provide the Service much more leverage in dealing with other federal agencies in terms of requiring mitigation and alteration (or even termination) of projects that do not have the effect of potentially eliminating a species, but make it harder for the species to recover. The Service could also use this additional regulatory authority to require agencies to take

³⁴⁸ See discussion *supra* Part V.A.3.a (discussing the federal actions covered by section 7 consultation). However, EPA's and the Service's efforts in this field have a long way to go. There are open questions about whether their interpretation of the CWA and the ESA would be lawful. See discussion *infra* Part VIII. Moreover, even if EPA can require states to revise their water quality standards to avoid harm to listed species, such a process will require an extended period of time to implement (at least three years, since review is triennial, and probably much longer, since the process is rarely, if ever, completed in time). In addition, the lack of knowledge about what kinds and levels of water pollution are harmful to freshwater mussel species would slow down the development of appropriate standards. Finally, even if standards are set, EPA has yet to truly translate these standards into actual reductions of inputs of pollution (from point and nonpoint sources) such that the standards could be complied with. It has taken years of lawsuits by environmental groups to force states and EPA to convert the water quality standards into total maximum daily load (TMDL) levels, which quantify the amount of pollution that can be discharged into an entire water system without causing the water system to fail to meet water quality standards. Moreover, it is still unclear under the law whether EPA or the states can force point sources to reduce their discharges in order for overall discharges into the water system to be brought below the TMDL, or whether the TMDL provisions only apply to nonpoint sources. Oliver A. Houck, *TMDLs, Are We There Yet?*, 27 *Envtl. L. Rep. (Envtl. L. Inst.)* 10,391, 10,398 (1997).

greater steps to address indirect effects of their actions, such as the development that results from construction projects.³⁴⁹ Nonpoint pollution would be a prime example of the type of indirect harm that a broader critical habitat definition could address.

The third possible administrative solution would be a much more expansive, and more effective, interpretation of section 7(a)(1) of the ESA—the provision that imposes an affirmative duty on federal agencies to conserve and recover listed species. Holistic, larger-scale, and more comprehensive analysis of the impact of federal projects (and of their interaction with the impact of private projects) is necessary to address the nonpoint source threat to freshwater mussels, but such an analysis is much more difficult in the context of consultation over individual projects, as discussed above. However, if agencies build the concept into their everyday activities of actively thinking about how to minimize impacts on listed species, and even to recover those species so that less protection would be required in the future, such analysis can be achieved.³⁵⁰ Of course, given current court interpretations of section 7(a)(1), which have generally held that this provision is not judicially enforceable,³⁵¹ a more expansive interpretation would require spontaneous, unilateral action by federal agencies or an attempt by the Service to enforce this duty on agencies. Neither appears likely to happen.

The causation issues raised in the context of freshwater mussels have a much broader applicability. Causation can present a serious difficulty in the enforcement of the ESA in general. Environmental harms, including the endangerment and extinction of species, often result from the cumulative impact of numerous individual actors who cannot be precisely identified. Actions that initially seem innocent can result in unforeseen, but serious, environmental damage. The limitations on legal causation in the context of the ESA, as with other environmental harms, can make enforcement and prevention of harm extremely difficult or impossible.³⁵² While changes to the

³⁴⁹ The current lawsuits by environmental groups to force the designation of critical habitat are the first step in just such a process—after the designation of critical habitat for listed species, an environmental group could then challenge the Service's current definition of critical habitat, and adverse modification of critical habitat, as unlawful. The result would then be a much stricter level of protection for listed species within those designated areas. Bergoffen Interview, *supra* note 340.

³⁵⁰ Hartfield Interview, *supra* note 33.

³⁵¹ BEAN & ROWLAND, *supra* note 118, at 236–39.

³⁵² For an example of the difficulty of causation issues in the context of the ESA with respect to terrestrial animals, see the discussion by the Supreme Court of the *Palila* case in its *Sweet Home* decision. *Babbitt v. Sweet Home Chapter of Cmty. for a Great Or.*, 515 U.S. 687 (1995). In the *Palila* case, an environmental group was able to obtain an injunction requiring Hawaii to remove feral sheep and goats from the habitat of an endangered bird species because the goats and sheep were slowly destroying the forest habitat of the bird species through grazing, and were also preventing the regeneration of the forest habitat. *Palila v. Hawaii Dep't of Land & Natural Resources*, 471 F. Supp. 985, 996–98 (D. Haw. 1979), *aff'd*, 639 F.2d 495 (9th Cir. 1981). Justice O'Connor's concurrence in *Sweet Home* expressed serious doubt about whether such a fact pattern could support proximate (as opposed to factual) causation connecting the state of Hawaii to the harm to the individual birds. *Sweet Home*, 515 U.S. at 733. Obviously, a narrower conception of proximate causation, as advocated by Justice O'Connor,

interpretation of the CWA and its interaction with the ESA would not be relevant to terrestrial species, a more aggressive and effective interpretation and implementation of both critical habitat and section 7(a)(1) could address the gaps in causation in the current structure of the ESA, and provide substantial additional benefit to protect listed species both on land and in the water.

The third conclusion of this case study is by far the most important: Contrary to the critics who question the lack of prioritization in the ESA, one of the reasons for the limited recovery success of the ESA may very well be prioritization itself. The ESA has had so little success recovering freshwater mussels, in part, because resources have not been allocated to recover freshwater mussels, (as opposed to other taxonomic groups that contain charismatic megafauna such as condors and manatees). The decision to allocate or not to allocate resources to a particular taxonomic group is not made alone by the Service seeking to maximize its positive publicity. Instead, it is a result of biases present within Congress, the environmental community, and the Service itself. However, this prioritization decision is not made explicit in the statute, which technically forbids prioritization based on taxonomy status as a "higher or lower" life form, or in the administrative regulations' priority guidelines, which also do not consider taxonomy.

The question might be whether the ESA should be changed to make these prioritizations explicit. One could argue that greater transparency and better political debate might result in clarifying the process for the public and various interest groups, which in turn might be able to make better decisions about which species to save, and save more species.

On the other hand, perhaps the result would be to reduce the resources spent on the overall protection of endangered species, with species such as freshwater mussels left entirely to their own devices and to face the doom of complete extinction. The aspirational message that all species count equally may not be entirely true in practice, but it might at least spur greater action in preserving all species. Without the constant reminder of the ESA that there are species in peril, and that there has been a legislative promise to protect them, some species may not be considered at all, or at least less than they would be in an ideal world. This was the conclusion of all of the biologists interviewed who emphasized that, despite the dire straits of listed mussel species and the lack of resources for mussel protection, the ESA has been a success precisely because without the ESA no attention whatsoever would have been given to freshwater mussels in the first place.

The argument is, then, that explicit prioritization is counterproductive. If the law were to explicitly provide higher and lower priorities for species in terms of protection, society would have a reason to ignore the lower priority species. The result would be that, in practice, those lower priority species would receive far less protection than the law would, in theory, provide.³⁵³ It

would have reduced the effectiveness of the ESA as a legal tool to protect the endangered bird species, and it is very possible that the bird species might have gone extinct as a result.

³⁵³ The reason would be that because those species are easy to ignore (probably for the very

seems hard to believe that providing a lower level of protection for freshwater mussels under the ESA than for mammals or birds would result in the same level of protection as they receive today (which is already effectively less than for mammals or birds). Instead, the result would very likely be far less protection, or none at all.

This lesson from the ESA is not unique to endangered species. Indeed, it may be a lesson that is much more broadly applicable in environmental law. Environmental problems are diffuse, hard to observe, hard to measure, and hard to feel in daily life. The actions that lead to those problems are often very concrete in their benefits, easy to observe, easy to measure in terms of economic benefits, and often integral to day-to-day life. Society may very well use laws concerning clean air, clean water, environmental impact statements, and endangered species to remind itself about these hidden problems, to make sure that they are not forgotten, and to ensure that more consideration is provided to those problems than otherwise would be given. This conclusion is hardly new in the environmental law literature,³⁵⁴ but the case study of freshwater mussels provides a clear example of the importance of using absolute laws, which in practice only result in partial protection, to achieve protection that otherwise would never occur.

reasons that they would be given lower priority, such as lack of charisma or economic value), they would be ignored far more than is desirable in an ideal world, simply because of the press of other considerations, economic gain, and collective action failures.

³⁵⁴ Carol Rose, *Environmental Lessons*, 27 *LOY. L.A. L. REV.* 1023, 1024-31 (1994).

| <i>Project Type</i> | |
|----------------------------------|--------|
| Bridge Construction/Removal | 11 |
| Road Construction | 2 |
| Dam or Lock Construction | 1 (1) |
| Water Quality Standards | 1 |
| National Park Management Plan | 1 |
| Dock/Mooring Construction | 3 |
| Forest Management Plan | 1 |
| Sewage Outfall | 1 |
| Nuclear Power Plant Licensing | 1 |
| Fish Stocking | 1 (1) |
| Captive Translocation of Mussels | 1 |
| Land Sales | 1 |
| Dredging/Channel Maintenance | 2 |
| <i>Totals:</i> | 28 (2) |

Note: Numbers do not add up to the total because some biological opinions covered more than one type of project. Numbers in parentheses represent supplemental biological opinions for a project already covered by a reviewed biological opinion.

| Table 2: Types of Terms and Conditions Required in Biological Opinions Reviewed | | | | | | | | | | |
|---|-----------------------------|--------------------------|----------|-------------------|-----------------------|---------------------------|------------------------|-------------------|---------------|--------------------|
| | Bridges/Road/ Dams/Locks | Water Qual. Standards | Dredging | Docks/ Mooring | Forest Mngt. Plans | Sewage Outfall Constr. | Nuclear Power Plant | Fish- Stocking | Land Sales | Nat'l Park Plan |
| Timing of Constr. | 10 | | | 2 | | | | | | |
| Restrictions on Water Flows | 2 | | | | | | | | | |
| Location of Constr. | 10 | | | | | | | | | |
| Survey for Mussels | 3 | | 1 | | | 1 | | | | |
| Controls on Sediment/Vegetation | 13 | | | 2 | | | | | | |
| Controls on Spills of Chem. or Emergency Plans | 5 | | | | | | 1 | | | |
| Little or No Instream Work Allowed | 4 | | | | | | | | | |
| Research on Impacts | 3 | | | | | | 1 | 1 | | |
| Translocation to Avoid Project Impacts | 6 | | 2 | | | 1 | | | | |
| Zebra Mussel Monitoring/Controls | 1 | | 1 | | | | | | 1 | |
| Restrictions on Concrete Usage | | | | | | | | | | |
| Public Outreach/Education | | | 1 | | | | | | 1 | |
| Restrict Access to Boaters | | | | | | | | | | 1 |
| No Dredging Allowed | | | | 1 | | | | | | |
| Restrictions on Boat Movement | | | | 2 | | | | | | |
| Restrictions on Duration of Activities | | | | 1 | | | | | | |
| Require Species Protected Under State Water Quality | | 1 | | | | | | | | |
| No Mixing Areas Allowed for Outfalls | | 1 | | | | | | | | |
| Monitoring of Numbers | | | 1 | 3 | | | 1 | | | |
| No Fish Stocking Where Listed Species Present | | | | | | | | 1 | | |
| Deed Restrictions to Prevent/Control Dev. | | | | | | | | | 1 | |

Biological Opinions Reviewed for Tables 1 and 2:

U.S. Fish and Wildlife Serv., Cookeville Field Office, Biological Opinion for Endangered Species Approval for the Rescue of Critically Endangered Mussels (Oct. 1996).

U.S. Fish and Wildlife Serv., Cookeville Field Office, Biological Opinion for the Proposed City of Florence Municipal Treated Sewage Outfall, Tennessee River (TRM 254.7) Lauderdale County, Alabama.

U.S. Fish and Wildlife Serv., Pennsylvania Field Office, Letter Serving as Biological Opinion for Proposed Replacement of Kennerdell Bridge (Feb. 3, 1998).

U.S. Fish and Wildlife Serv., Vermont Field Office, Letter Serving as Biological Opinion for U.S. Route 2 Reconstruction (Nov. 19, 1996).

U.S. Fish and Wildlife Serv., West Virginia Field Office, Letter Serving as Draft Biological Opinion to Joe S. Towing Company (Mar. 18, 1997).

U.S. Fish and Wildlife Serv., Memorandum from Assistant Regional Division (AES) to Assistant Regional Division (FA) (Feb. 14, 1996) (FWS/R4/AES/FA).

U.S. Fish and Wildlife Serv., Cookeville Field Office, Biological Opinion for the Proposed Operation of the Watts Bar Nuclear Power Plant, Rhea County, Tennessee.

U.S. Fish and Wildlife Serv., West Virginia Field Office, Letter Serving as Biological Opinion for Letart Corporation Barge Loading Facility (March 16, 1999).

U.S. Fish and Wildlife Serv., West Virginia Field Office, Letter Serving as Biological Opinion for Richard and Sons' Barge Loading Facility (Aug. 18, 1999)

U.S. Fish and Wildlife Serv., Biological Opinion for the Operation and Maintenance of the 9-Foot Navigation Channel of the Upper Mississippi River Channel (May 15, 2000).

U.S. Fish and Wildlife Serv., Letter Serving as Biological Opinion For Draft Cooperative Management Plan for the Lower St. Croix National Scenic Riverway.

U.S. Fish and Wildlife Serv., Letter Serving as Biological Opinion for Relocation of 1.3 miles of the Clinch River (May 17, 1978).

U.S. Fish and Wildlife Serv., Letter Serving as Biological Opinion for Route 665 Bridge Replacement (Oct. 28, 1999).

U.S. Fish and Wildlife Serv., Letter Serving as Biological Opinion for Route 649 Bridge Replacement (Sept. 8, 1998).

U.S. Fish and Wildlife Serv., New Jersey Field Office, Biological Opinion on the Effects of the U.S. Environmental Protection Agency's Approval of the State of New Jersey's Surface Water Quality Standards on the Bald Eagle, Peregrine Falcon, and Dwarf Wedgemussel (June 1996).

U.S. Fish and Wildlife Serv., Virginia Field Office, Letter Serving as Biological Opinion for Construction of New Route 72 Bridge (Oct. 28, 1997).

U.S. Fish and Wildlife Serv., Virginia Field Office, Letter Serving as Biological Opinion for Repair of Route 636 Bridge, (Jan. 26, 1995).

U.S. Fish and Wildlife Serv., Cookeville Field Office, Supplement to the

1991 Biological Opinion for the Proposed Bridges and Alignments Modification to the Kentucky Lock Addition Project, Livingston and Marshall Counties, Kentucky (Jan. 2000).

U.S. Fish and Wildlife Serv., Cookeville Field Office, Biological Opinion for the Proposed Removal of the Old State Route 52 Bridge over the Clear Fork River, Fentress and Morgan Counties, Tennessee (Feb. 2000).

U.S. Fish and Wildlife Serv., Cookeville Field Office, Biological Opinion for the Land and Resource Management Plan and the Proposed Special Habitat Needs and Silviculture Amendment, Daniel Boone National Forest, Kentucky (May 2000).

U.S. Fish and Wildlife Serv., Letter Serving as Biological Opinion for the construction of a new navigation lock at Kentucky Lock and Dam in Livingston and Marshall Counties, Kentucky (Mar. 26, 1991).

U.S. Fish and Wildlife Serv., Letter Serving as Supplemental Biological Opinion for the Proposed Olmsted Lock and Dam facility on the Ohio River in Ballard County, Kentucky (Jan. 15, 1993).

U.S. Fish and Wildlife Serv., Letter Serving as Biological Opinion for the Construction of Portion of Route 29, Virginia (June 5, 1998).

U.S. Fish and Wildlife Serv., Letter Serving as Biological Opinion for Replacement of Bridge for Route 40, Virginia.

U.S. Fish and Wildlife Serv., Letter Serving as Biological Opinion for Replacement of Bridge for Route 40, Virginia (Apr. 17, 1998).

U.S. Fish and Wildlife Serv., Cookeville Field Office, Biological Opinion for the Proposed Replacement of the Old State Route 52 Bridge over the Clear Fork River, Fentress and Morgan Counties, Tennessee (July 1997).

U.S. Fish and Wildlife Serv., Cookeville Field Office, Biological Opinion for the Proposed Maintenance Dredging in the Tennessee River at Diamond Island, Hardin County, Tennessee.

U.S. Fish and Wildlife Serv., Cookeville Field Office, Biological Opinion for the Proposed Disposition of Lands Acquired by the Tennessee Valley Authority for the Columbia Dam Project, Maury County, Tennessee (Mar. 1999).

| | |
|--------------------------------|----|
| Low Gene Pool/Low Gene Flow | 6 |
| Oil/Gas/Mining Runoff | 8 |
| Non-point Pollution | 11 |
| Overharvesting/Incidental Take | 4 |
| Industrial Pollution | 8 |
| Disease | 1 |
| Flow Changes | 4 |
| Water Temperature Changes | 6 |
| Dredging | 10 |
| Dams/Channelization | 16 |
| Gravel Mining | 8 |
| Sedimentation | 11 |
| Sewage Outfalls | 6 |
| Exotic Species | 7 |
| Predation | 1 |
| Host Fish | 4 |
| Beaver Dams | 1 |

| Table 4: List of Management Steps Outlined by Recovery Plans | |
|---|----|
| Improve Enforcement/Application of Laws | 19 |
| Improve Water Quality Standards | 7 |
| Education | 15 |
| Land Acquisition | 8 |
| Research | 20 |
| Surveys | 16 |
| Captive Breeding | 13 |
| Translocation/Reintroduction & Habitat Restoration | 19 |
| Cryogenic Preservation | 8 |
| Monitor | 19 |
| Change Streamflow | 1 |
| Emergency Response Planning | 1 |
| Designate Critical Habitat | 1 |
| Predator Control | 1 |
| Restrict Collection | 1 |
| Control Exotics | 2 |
| Reduce Pesticide Use | 2 |
| Watershed Planning/Non-Point Pollution/National Forest Management | 4 |
| Restrict Gravel Mining | 1 |
| Improve Wastewater Management | 1 |
| Voluntary Stewardship | 1 |

Note: Twenty recovery plans were examined. The inflated heelsplitter and the five Tombigbee river mussel species were also covered by the Mobile River Basin Aquatic Ecosystem Recovery Plan.

Recovery Plans Reviewed for Tables 3 and 4:

- U.S. FISH AND WILDLIFE SERV., FANSHELL RECOVERY PLAN (1991).
- U.S. FISH AND WILDLIFE SERV., PURPLE CAT'S PAW PEARLYMUSSEL RECOVERY PLAN (1990).
- U.S. FISH AND WILDLIFE SERV., APPALACHIAN ELKTOE RECOVERY PLAN (1996).
- U.S. FISH AND WILDLIFE SERV., CAROLINA HEELSPLITTER RECOVERY PLAN (1996).
- U.S. FISH AND WILDLIFE SERV., CRACKING PEARLYMUSSEL RECOVERY PLAN (1990).
- U.S. FISH AND WILDLIFE SERV., HIGGINS' EYE RECOVERY PLAN (1983).
- U.S. FISH AND WILDLIFE SERV., ARKANSAS FATMUCKET MUSSEL RECOVERY PLAN (1992).
- U.S. FISH AND WILDLIFE SERV., JAMES SPINYMUSSEL RECOVERY PLAN (1990).
- U.S. FISH AND WILDLIFE SERV., REVISED TAR SPINYMUSSEL RECOVERY PLAN (1992).
- U.S. FISH AND WILDLIFE SERV., WINGED MAPLELEAF MUSSEL RECOVERY PLAN (1997).
- U.S. FISH AND WILDLIFE SERV., INFLATED HEELSPLITTER RECOVERY PLAN (1992).
- U.S. FISH AND WILDLIFE SERV., FIVE TOMBIGBEE RIVER MUSSEL RECOVERY PLAN (1989).
- U.S. FISH AND WILDLIFE SERV., FAT POCKETBOOK PEARLY MUSSEL RECOVERY PLAN (1989).
- U.S. FISH AND WILDLIFE SERV., LITTLE-WING PEARLY MUSSEL RECOVERY PLAN (1989).
- U.S. FISH AND WILDLIFE SERV., WHITE CAT'S PAW PEARLYMUSSEL RECOVERY PLAN (1990).
- U.S. FISH AND WILDLIFE SERV., LOUISIANA PEARLSHELL RECOVERY PLAN (1990).
- U.S. FISH AND WILDLIFE SERV., SPECKLED POCKETBOOK MUSSEL RECOVERY PLAN (1991).
- U.S. FISH AND WILDLIFE SERV., CUMBERLAND PIGTOE MUSSEL RECOVERY PLAN (1992).
- U.S. FISH AND WILDLIFE SERV., CLUBSHELL/NORTHERN RIFFLESHELL RECOVERY PLAN (1994).
- U.S. FISH AND WILDLIFE SERV., MOBILE RIVER BASIN AQUATIC ECOSYSTEM RECOVERY PLAN (2000).

