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I. INTRODUCTION

Twenty years after its enactment, the Endangered Species Act (ESA)[1] is still controversial. Conservationists criticize the Act as slow and ineffective while business leaders complain it protects marginal species at the cost of jobs. In the heat of these debates little attention has been paid to a fundamental question: What does the Endangered Species Act mean by "species"?

Determining a species' eligibility for protection under the Act affects the allocation of the available resources to conserve all endangered species. In fiscal year 1992, the Federal government allocated $50.5 million to manage over 650 species.[2] Taxonomic decisions not to list a species can result in the tragedy of a species' extinction; but poor taxonomic decisions inappropriately listing a species can result in misallocation of limited resources.

In 1990, a group of molecular geneticists reported that they had conducted DNA tests on a group of Florida panthers, a subspecies of the cougar.[3] The results of the test indicated that at least one population of the animal was not a true subspecies but was perhaps instead a hybrid with genetic stock introduced from a subspecies native to Central and South America.[4] The panther's pedigree was

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[1] 16 U.S.C. §§ 1531–44 (West 1985 & Supp. 1992).

[2] United States General Accounting Office, Endangered Species Act, Types and Number of Implementing Action, GAO/RCED-92–131BR 9, 25 (May 1992).

[3] Stephen J. O'Brien, et al., *Genetic Introgression Within the Florida Panther* Felis Concolor cory, *in* 6 NAT'L GEOGRAPHIC RES. 485, 486 (1990).

[4] *Id.* at 491–92.

important because it established the cat's status as a protected species under the Endangered Species Act.[5] Whether the protections of the Act should extend to hybrids is an issue which has taken backstage in the current economic arguments over the Act but is just as important to the Act's long term effectiveness. How pure must a species be to be protected?[6]

The Florida panther study is but one of a number of studies of endangered animals that have raised questions about how a species should be defined and what conservation efforts should be addressed to hybrids.[7] As a result, an otherwise obscure and esoteric scientific debate has entered the political arena. In a list of six questions about the Endangered Species Act that Congress sent to the National Academy of Sciences, the first question was how to apply the concept of species.[8]

Section II of this Article briefly examines the Endangered Species Act, paying particular attention to the Act's definition of species and its effect on hybrid policy. Section III provides an overview of taxonomy, demonstrating the problems associated with classifying animals according species. Section IV illustrates the problem with the Endangered Species Act's definition of species by discussing the plights of the red wolf and the Dusky Seaside Sparrow. In Section V, the Article concludes that the Act's definition of species is inadequate and proposes factors that should be included in a revised definition of species.

II. THE ENDANGERED SPECIES ACT AND THE PROBLEM OF HYBRIDS

A. The Act

The Endangered Species Act is a direct result of the environmental consciousness that swept the nation in the late 1960's and early 1970's. Two predecessor laws, the Endangered Species Preservation Act of 1966[9] and the Endangered Species Conservation Act of 1969[10] afforded threatened wildlife some limited protection but did not

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[5] 32 Fed. Reg. 4001 (1967).

[6] The question is not hypothetical. In 1990, the Fish and Wildlife Service considered a petition to delist the gray wolf (*Canis lupus*) because of extensive hybridization. 55 Fed. Reg. 49,656, 49,656 (1990) (denying petition).

[7] *See, e.g., infra* notes 113-35 and accompanying text.

[8] NAT'L J.'S CONGRESS DAILY, (Feb. 5, 1992) (LEXIS, Nexis library, CNGDLY file).

[9] Pub. L. No. 89-669, 80 Stat. 926 (1966).

[10] Pub. L. No. 91-135, § 5, 83 Stat. 278 (1969).

provide a comprehensive scheme to protect and encourage the recovery of endangered species. In 1973, Congress enacted a comprehensive species protection program. This Act, the Endangered Species Act of 1973 passed unanimously in the Senate and with only four dissenting votes in the House.[11]

The ESA was enacted to identify and to conserve plant and animal species threatened with extinction.[12] It defines species to include "any subspecies of fish or wildlife of plants, and any distinct population segment of any species . . . which interbreeds when mature."[13] The Secretaries of the Interior and Commerce share responsibility for the Act's implementation.[14] As a practical matter, it is Interior's Fish and Wildlife Service and Commerce's National Marine Fisheries Service which administer and interpret the Act.[15]

The ESA directs the Secretaries to determine, on the basis of scientific evidence alone, whether any species of plant or animal is endangered or threatened.[16] Any person or organization may petition the Fish and Wildlife Service or the National Marine Fisheries Service to list a species as endangered or threatened.[17] The listing of a species limits activities that could harm the species or its habitat.[18] The ESA prohibits the "taking" of a listed species.[19] "Taking" includes harming, harassing, hunting, shooting, killing, trapping, capturing and collecting.[20]

The Act also mandates that the listing agency designate what is critical habitat for the species.[21] Critical habitat is the geographic area deemed crucial to the continued viability of an endangered species.[22] Once an area has been designated as a critical habitat

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[11] 119 CONG. REC. 25,694, 42,915 (1973).

[12] 16 U.S.C. § 1531(b).

[13] 16 U.S.C. § 1532(16).

[14] 16 U.S.C. § 1533(2).

[15] The Fish and Wildlife Service, however, is the principal actor in implementing the Act. *See* GAO, *supra* note 2, at 19. Of the approximately 650 species listed, the Fish and Wildlife Service is responsible for over 95%. *Id.*

[16] 16 U.S.C. § 1533(b). It makes no appreciable difference whether a species is afforded "threatened" or "endangered" status in the amount of domestic protection it will receive. An endangered species is any species at risk of extinction in all or a significant portion of its range. 16 U.S.C. § 1532(6). A threatened species is one that is likely to become endangered in the foreseeable future in all or a significant portion of its range. 16 U.S.C. § 1532(20).

[17] 16 U.S.C. § 1533(b)(3)(A).

[18] 16 U.S.C. § 1533(c)–(d).

[19] 16 U.S.C. § 1538(a)(1)(C).

[20] 16 U.S.C. § 1532(19).

[21] 16 U.S.C. § 1533(b)(2).

[22] 16 U.S.C. § 1532(5)(A)(i).

federal actions that adversely affect these areas may be prohibited. Designation of critical habitat is an effective conservation tool but can be extremely controversial because of the potential economic consequences.[23] In addition to protecting endangered species, the ESA requires that the Fish and Wildlife Service and the National Maritime Fisheries Service develop and implement a recovery plan to reverse the decline of each listed species and bring them to the point where they no longer require the Act's protection.[24]

At first glance, it would be hard to imagine an animal that deserves protection more than the Florida panther (*Felis concolor coryi*). It is a medium sized, dark, tawny cat with less than fifty representatives left in the wild.[25] Like its sibling subspecies the eastern cougar (*Felis concolor cougar*), the Florida panther's decline was the result of hunting, trapping, and habitat destruction. As farmers cleared forests for farmland the panther's natural habitat was destroyed. Deprived of their natural prey, the cats turned to livestock, and bounties were offered for killing them.[26] The panther's range was finally reduced from the entire southern United States to a few small areas in south Florida.[27] It is probably the most endangered animal in the United States and there is a good chance it cannot be saved.

The Florida panther has been protected since 1967.[28] The panther has been the object of massive conservation and recovery efforts, including the creation of a 30,000 acre refuge next to the Big Cypress National Preserve.[29] After the Fish and Wildlife Service estimated that the animal would be extinct within twenty-five years, state and federal wildlife authorities began an intense captive breeding program.[30]

The current threat to the conservation of the Florida panther, however, is more prosaic than hunting and habitat-destruction. In the late 1950s and 1960s, a number of captive cougars were released in the Florida Everglades, with the permission of the Fish and

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[23] James Salzman, *Evolution and Application of Critical Habitat under the Endangered Species Act*, 14 HARV. ENVTL L. REV. 311, 311–12 (1990).

[24] 16 U.S.C. § 1533(f).

[25] U.S. FISH AND WILDLIFE SERVICE, FLORIDA PANTHER RECOVERY PLAN 3 (1987) [hereinafter FLORIDA PANTHER RECOVERY PLAN].

[26] *Id.* at 10.

[27] *Id.* at 9.

[28] Native Fish and Wildlife, Endangered Species 32 Fed. Reg. 4001 (1967); 50 C.F.R. § 1711 (1991).

[29] Philip Shabecoff, *30,000-Acre Refuge Created for Endangered Florida Panther*, N.Y. TIMES, June 20, 1989 at A16.

[30] Chuck Fergus, *The Florida Panther Verges on Extinction*, 251 SCIENCE 1178 (Mar. 8, 1991).

Wildlife Service.[31] Unfortunately, the released cats were not pure Florida cougars. At least part of their parentage came from two distinct subspecies normally not found in North America—*Felis concolor araucanus* and *Felis concolor papgonica*.[32]

Ordinarily, introducing outside stock into a population is helpful both to increase the number of members in the population and avoid the deleterious effects of inbreeding.[33] The ESA, however, does not address genetic hybrids, and the past administrative treatment of hybrids between species or subspecies under the Act is not encouraging.

B. The Hybrid Policy

The Department of Interior's Hybrid Policy was established in a series of legal opinions issued by Interior's Office of the Solicitor over a thirteen-year period.[34] In late 1990, after the Fish and Wildlife Service sponsored a workshop focusing on the problem of hybrids, the Solicitor's office withdrew the legal opinions pending further review.[35] As of this writing there is no hybrid policy but the history of the policy illustrates the difficulties with and the importance of defining "species" under the ESA.

The first Solicitor's opinion, in 1977, was in response to a general inquiry as to the status of hybrids by the Division of Law Enforcement of the Fish and Wildlife Service.[36] The Solicitor concluded that the ESA covered hybrids.[37] The opinion was based on the language of the statute. The statute defines "fish or wildlife" to include "any member of the animal kingdom, including without limitation any mammal, fish, bird, . . . amphibian, reptile, mollusk, crustacean, arthropod, or other invertebrate, and includes *any* part, product, egg or *offspring thereof*, or the dead body or parts thereof."[38]

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[31] *Id.*

[32] *Id.*

[33] COLIN TUDGE, LAST ANIMALS AT THE ZOO 70–75 (1992). The heavy inbreeding of the Florida Panther has produced some abnormal traits that are harmless—a kink in the tail, and a fur "cowlick"—and others that are not—more than 90% defective sperm. FLORIDA PANTHER RECOVERY PLAN, *supra* note 25, at 10.

[34] Memorandum from Assistant Solicitor, Fish and Wildlife, to Director, U.S. Fish and Wildlife Service (Dec. 14, 1990) (on file with author). A hybrid is a cross between two species or subspecies.

[35] *Id.*

[36] Memorandum from Assistant Solicitor, Fish and Wildlife, to the Chief, Division of Law Enforcement Fish and Wildlife Service (May 18, 1977) (on file with author).

[37] *Id.*

[38] 16 U.S.C. § 1432(5) (emphasis added). Because the definition of plant at 16 U.S.C. § 1432(9) failed to include the "any . . . offspring" language, the Solicitor had to reconcile the

The Solicitor reasoned that a plain reading of the Act included *any* offspring of a protected animal without limitation.[39] Thus, a plain reading of the statute supported the inclusion of hybrid offspring.[40] The Solicitor found additional support for this position in the threat of crossbreeding protected species with unprotected species to produce hybrids for commercial exploitation.[41] The Solicitor speculated that " . . . the drain on protected species resulting from taking for crossbreeding purposes will be the same as if commercialization were allowed of purebreds."[42]

This simple policy was short lived. At the request of the Fish and Wildlife Service, the Solicitor reviewed and reversed the earlier opinion.[43] According to the new view, hybrids were a threat to endangered species because they might interbreed with the purebreds and dilute or eliminate the original gene pool.[44] The Solicitor perceived an additional threat in vigorous hybrids taking over the habitat or environment essential to the protected species's survival.[45] It followed then, that inclusion of hybrids conflicted with the conservation of endangered species.[46] The Solicitor reasoned that the intent of Congress was to protect endangered species; if hybrids were a threat to that protection they must be excluded from protection.[47]

The Fish and Wildlife Service's concerns about hybridization threatening conservation efforts were valid. A frequent result of hybridization is the phenomenon known as outbreeding depression.[48]

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two definitions by resorting to legislative history that indicated that plants are to be afforded the same protection as animals.

[39] Memorandum of May 18, 1977, *supra* note 36, at 2.

[40] *See id.*

[41] *Id.*

[42] Memorandum of May 18, 1977, *supra* note 36, at 3.

[43] Memorandum from Assistant Solicitor, Fish and Wildlife, to Deputy Associate Director, Federal Assistance, Fish and Wildlife Service 1 (Aug. 2, 1977) (on file with author).

[44] *Id.*

[45] *Id.*

[46] *Id.*

[47] *Id.* at 2–3.

[48] Alan R. Templeton, *Coadaptation and the Outbreeding Depression*, *in* CONSERVATION BIOLOGY 105 (Michael E. Soule ed., 1986). The classic example of outbreeding depression is when someone crosses a horse with a mule. *See* Tudge, *supra* note 33. at 96–98. The result is sterile. Not all manifestations of the phenomena, however, are this obvious. *Id.* at 96. The hooded crows of North Scotland hybridize with the carrion crows of South Scotland and England but the hybrids fail to establish themselves, even though they are fertile, because they are not as fit as their parent species. *Id.*

Outbreeding depression can, in part, be explained by natural selection. *Id.* at 96-97. If a population is divided into two or more sub-populations, then each sub-population is liable to

This refers to reduction in the fertility or viability of organisms following hybridization. Outbreeding depression can occur in the immediate hybrids, in subsequent hybrid generations or in backcrosses to the parent species.[49] Yet, hybridization can be an important tool in conserving endangered species.

Some three years later, the problem of hybrids between subspecies surfaced.[50] For the first time the Solicitor had to deal with a specific animal rather than a general policy. The subspecies in question was the Dusky Seaside Sparrow (*Ammodramus maritimus nigrescens*), a subspecies of the Seaside Sparrow (*Ammodramus maritime*), that until recently was found on the eastern coast of Florida.

At the time the legal opinion was sought, the Dusky Seaside Sparrow (Dusky) was in critical decline. Development and the draining and drying of marshes eliminated the bird's habitat.[51] By 1978 only twenty-four males could be found. Biologists suggested a plan to cross five of the birds with a morphologically similar subspecies found on Florida's gulf coast the Peninsular Seaside Sparrow (*Ammodramus maritimus peninsulae*). In the proposed recovery plan, the hybrids would be bred back to purebred surviving Duskies.[52]

The Solicitor's opinion concluded that a hybrid of the "Dusky" would not be protected under the ESA.[53] Therefore, federal funds could not be used to produce a hybrid. The Dusky Seaside Sparrow became extinct in 1987.

In September 1983, the Solicitor's office reaffirmed this interpretation of the ESA when it concluded that hybrids between two listed

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adapt through natural selection to slightly different environments. *Id.* at 96. A hybrid between the two may not be as well adapted to either particular environment, and will not be able to compete as well as the parents that are adapted to a particular environment. *Id.*

Outbreeding depression can also be explained by genetic adaptation. *Id.* Genes may have adapted to work with other genes. *Id.* When genes from one population are mixed with another they do not match as well and as a result don't work together efficiently. *Id.* For example, genes operate by producing proteins; and proteins often function as enzymes. *Id.* Enzymes, in general, work in coordination with other enzymes. *Id.* Any two animals of the same breeding population will generally have the same enzymes. *Id.* But if two populations have separated genetically, then they could produce enzymes that are significantly different and do not work well together when mixed. *Id.* This will bring about a small but perhaps significant loss of fitness. *Id.*

[49] Templeton, *supra* note 48, at 105.

[50] Memorandum from Assistant Solicitor, Fish and Wildlife, to Associate Director, Federal Assistance, Fish and Wildlife Service (May 6, 1981) (on file with author).

[51] An eloquent account of the mismanagement of the Dusky Seaside Sparrow can be found in Charles C. Mann & Mark L. Plummer, *The Butterfly Problem*, 269 THE ATLANTIC 47, 56–59 (Jan. 1991).

[52] *Id.*

[53] Memorandum of May 6, 1981 *supra* note 50.

species, the red wolf (*Canis rufus*) and the gray wolf (*Canis lupus*) were not entitled to protection.[54] At issue were two wolves that were hybrids between the two species. The rationale behind the hybrid policy was put succinctly in the opinion.

"While the entire genetic stock of such a hybrid would be that of the two endangered species, it would not be in such a form as to protect either of the two pure genetic stocks of the parents. That is to say, if two wolves of the type at issue here (hybrids between red and gray) were themselves to be bred, they would not produce purebred red wolves and purebred gray wolves. The genetic heritage of the gray wolf and the red wolf would thus not be conserved by the protection of the hybrids."[55] Importantly, the opinion made no distinction between artificial hybridization efforts and natural hybridization where the range of two species or subspecies overlap.

Finally, in 1984, the Fish and Wildlife Service asked the Solicitor if augmenting the protected herd of woodland caribou (*Rangifer tarandus caribou*) located in the Selkirk Mountains of Idaho with Canadian caribou would violate the ESA.[56] It is the last remaining caribou herd in the contiguous forty-eight states. By the early 1980's this herd had been reduced through habitat alteration and poaching to about twenty-eight members.[57] Part of the recovery plan for the Selkirk herd included augmenting the herd with caribou from Canada where the subspecies is plentiful.[58]

The Solicitor reasoned that the situation of the caribou was distinguishable from earlier questions since the crossbreeding would be between members of different populations of the same subspecies rather than between species or subspecies. This decision makes sense in regard to conserving the caribou but represents an artificial distinction between the treatment of subspecies and populations–a distinction that may not be scientifically justified.

The Solicitor's Hybrid Policy was an attempt to draw a bright line rule that would ease the administration of the ESA and provide for some predictability in the application of the statute. The ESA en-

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[54] Memorandum of the Assistant Solicitor, Fish and Wildlife, to the Regional Solicitor, Northeast Region, Fish and Wildlife Service (Sept. 21, 1983) (on file with author).

[55] *Id.* at 2.

[56] Memorandum from Assistant Solicitor, Fish and Wildlife, to Associate Director, Federal Assistance, Fish and Wildlife Service (Aug. 24, 1984) (on file with author).

[57] U.S. FISH AND WILDLIFE SERVICE, *Selkirk Mountain Caribou Management Plan* 10 (1985).

[58] *Id.*

visioned that species and subspecies were clearly defined concepts capable of precise identification. Nothing can be further from the truth. The flaw in the Hybrid Policy arises from a desire for a precision in taxonomic classifications such as species and subspecies that frequently does not exist. To examine this problem more carefully, we must briefly review the science of taxonomy.

III. A SHORT INTRODUCTION TO TAXONOMY

Taxonomy[59] is arguably the oldest of the biological disciplines. Defining taxonomy loosely as the naming and classification of plants and animals, Aristotle through his works *Historia Animalium* and *De Partibus Animalium* was the first serious taxonomist.[60] While his methods may not stand up to modern scientific scrutiny, he was the first to establish organizing principles for classification. Aristotle divided all animals into blooded animals and bloodless animals. He further divided the blooded animals into six groups: mammals, birds, cetacea, fish, serpents and reptiles;[61] and the bloodless into four: cephalopods, crustacea, testacea and insects.[62] While some modern biologists have mocked the quality of Aristotle's taxonomic observations,[63] they provided a starting place for classifying organisms by common physiological traits.

Despite Aristotle's contributions, the recognized "father of taxonomy" is Carl Linnaeus, an eighteenth century Swede.[64] Linnaeus developed a rigorous system of classifying organisms in a graded hierarchy:

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[59] Many scientists working in taxonomy today prefer the term "systematics," to reflect a discipline that looks beyond the naming of species and examines the evolutionary and ecological relationships among organisms. *See generally*, ERNST MAYR, SYSTEMATICS AND THE ORIGIN OF SPECIES 4–8 (1942) [hereinafter MAYER I].

[60] *See generally* G.E.R. Lloyd, *The Development of Aristotle's Theory of the Classification of Animals*, 6 PHRONESIS 59 (1961).

[61] *Id.* at 73.

[62] *Id.*

[63] In their acerbic and witty book, ARISTOTLE TO ZOOS, A PHILOSOPHICAL DICTIONARY OF BIOLOGY, P.B. Medawar and J.S. Medawar are a bit unfair when they write "The biological works of Aristotle are a strange and generally speaking rather tiresome farrago of hearsay, imperfect observation, wishful thinking, and credulity amounting to downright gullibility." P.B. Medawar & J.S. Medawar, ARISTOTLE TO THE ZOOS, A PHILOSOPHICAL DICTIONARY OF BIOLOGY 28 (1983). The Medawars have forgotten the wisdom of Sir Issac Newton's famous aphorism "If I have seen farther, it is by standing on the shoulders of giants." A more sympathetic view is found in ERNST MAYR, THE GROWTH OF BIOLOGICAL THOUGHT 149–54 (1982) [hereinafter MAYR II].

[64] MAYR II, *supra* note 63, at 171.

Kingdom
Class
Order
Genus
Species.[65]

It is to Linnaeus that we owe thanks for the two part Latin nomenclature system that is the bane of every school child studying biology.[66] In it, genus and species are indicated in the name. Genus is the class of animals of a certain affinity, in the sense that dogs, coyotes and wolves are all designated by *Canis*. Species designation is by the second name. Thus the timber wolf is *Canis lupus* and the common dog is *Canis familiaris*. Similarly, a subspecies can be indicated by adding a third Latin name. Thus the northern tundra wolf is *Canis lupus tundrarum*.

The system Linnaeus developed was one of straightforward identification through morphological characteristics.[67] Color of feathers or fur, arrangements of limbs, and other anatomical aspects were used to classify organisms into species and genus.[68] For Linnaeus, "Every species was . . . the product of a separate act of creation and was therefore clearly separated from all other species."[69] It would not be unfair to say that Linnaeus and his followers viewed the world as a series of pigeonholes, each housing a species. The job of a taxonomist was to place each organism in the right pigeonhole. This approach is typological taxonomy or essentialism.[70] Species are defined by their essences with each species being distinctly individual and immutable.[71]

The difficulty with this approach is that it requires taxonomists to separate essential attributes of a particular animal from its accidental attributes.[72] In this regard, Linnaean taxonomy was platonic. Living organisms merely reflected an ideal organism. The job of the taxonomist was to classify imperfect representations of some ideal type.

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[65] *Id.* at 171–80. The sequence from top to bottom and the customary indentation indicate decreasing scope or inclusiveness of the various levels. *See id.* Subsequently phylum and family were added to the hierarchy. *See id.* When sub and super categories such as subspecies or superphylum are added the whole progression becomes fairly complicated. *See id.*

[66] *Id.* at 173.

[67] *Id.* at 171–80.

[68] *See id.*

[69] MAYR I, *supra* note 59 at 108.

[70] MAYR II, *supra* note 63 at 258–60. Interestingly, late in his life, Linnaeus seems to have abandoned this position after finding mutations in plants. *Id.* at 259. Unfortunately, subsequent generations of taxonomists ignored his later writings. *Id.* at 259–60.

[71] *Id.* at 260.

[72] GEORGE G. SIMPSON, PRINCIPLES OF ANIMAL TAXONOMY 37, (1961).

Variation was a nuisance to be regarded as an irrelevant departure from the essential form. Nature was viewed as basically conservative if not completely static.

Darwin's publication in 1859 of the *Origin of Species* completely revolutionized taxonomy as well as the rest of biology. The theory that the natural world was not constant, but the product of a continuing process of evolution, was not original to Darwin.[73] Yet it took Darwin's exhaustive marshaling of facts and his systematic arguments detailing the mechanisms of evolution to convert virtually the entire scientific establishment to the evolutionary school.[74]

Because of Darwin, taxonomists began treating species as units of evolution.[75] Taxonomists were faced with rethinking taxonomic classifications to take into account descent of organisms from common ancestors.[76] For taxonomy to be rational it had to reflect the relative degrees of relatedness between animals.[77] Unfortunately, the first attempts to construct such a rational system were unduly influenced by the old essentialist approach of species definition, which used the degree of physical differences among individual animals to determine the genus.[78] Although morphology continued to supply the criteria for determining classification, this approach, frequently ran into problems with animals that did not look alike but interbred and animals that looked alike but did not interbreed.[79] The result was a nineteenth century mania for classifying organisms based on minor variations that resulted in thousands of species names.[80] What was needed was a clear definition of species that did not rely primarily on physical characteristics.

Contemporary biology provides myriad competing definitions of species.[81] In part, this is because the species category performs

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[73] The French naturalist, Jean Lamarck, had suggested evolution as a vehicle for the origin of species rather than divine creation. *See* MAYR II, *supra* note 63 at 343–63.

[74] For a general discussion of these developments *see generally* MAYR II, *supra* note 63.

[75] *Id.*

[76] *Id.*

[77] *Id.*

[78] *Id.*

[79] For example, in the eastern United States there are four very similar species of thrush: the Veery (*Catharus fuscenscens*), the Hermit Thrush (*Catharus guttatus*), the Olive-backed Thrush (*Cathar usustulatus*), and the Gray-cheeked Thrush (*Catharus minimus*). ERNST MAYR, POPULATION, SPECIES AND EVOLUTION 15 (1970) [hereinafter MAYR III]. According to Mayr, these four species are virtually indistinguishable to human observers until they sing. *Id.* Various behavioral differences, however, keep each species' gene pool isolated and intact. *Id.*

[80] *See* MAYR II, *supra* note 63 at 195–96; SIMPSON, *supra* note 73 at 172.

[81] For example: the phylogenetic concept of species, Joel Cracraft, *Species Concepts and Speciation Analysis*, 1 CURRENT ORNITHOLOGY 159 (1983); the cohesion concept of species,

different functions in different branches of biology. A definition of species that helps a biochemist may not help an evolutionary biologist.[82] Some writers have speculated that a general definition of species is impossible.[83] But all contemporary discussions of species reject the old essentialist view of static immutable categories and treat species as units of evolution.

The current definition of species most widely accepted is the Biological Species Concept—sometimes referred to as the isolation species concept—proposed in the early 1940's by Ernst Mayr, a Harvard evolutionary biologist.[84] The concept is called biological not because it deals with biological classifications but rather because the criteria are biological. Mayr describes a species as "a reproductive community of populations (reproductively isolated from others) that occupies a specific niche in nature."[85] Whooping Cranes (*Grus americana*), for example, are a different species from Sandhill Cranes (*Grus canadenis*) not because they look different but because they occupy slightly different ecological niches and do not interbreed.

The critical concept in Mayr's definition is reproductive isolation.[86] The existence of an isolating mechanism makes the organism a member of a distinct category. Examples of this mechanism include the sterility of hybrids or differences in breeding seasons. The mechanism isolates as long as it protects the species from contamination by other gene pools.[87] In short, a species is a protected gene pool.

Isolating mechanisms are not infallible, and when they fail, hybrid forms may appear.[88] Hybrids may be sterile, such as a mule, which

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Alan R. Templeton, *The Meaning of Species and Speciation: A Genetic Perspective*, *in* SPECIATION AND ITS CONSEQUENCES 12 (Otte & Endler eds., 1989); and the biological species concept discussed in detail in this text *infra* notes 84–108 and accompanying text.

[82] MAYR II, *supra* note 63, at 552.

[83] Joel Cracraft, *Species Concepts and the Ontology of Evolution*, 2 BIOLOGICAL PHIL. 330–31 (1987).

[84] Biologists generally accept the definition with some reservations. *See generally* Guy L. Bush, *Modes of Animal Speciation*, 6 ANN. REV. OF ECOLOGY AND SYSTEMATICS 339–64 (1975). *But see* Joel Cracraft, *Species Concepts and Speciation Analysis*, 1 CURRENT ORNITHOLOGY 1161–65 (1983) (which argues that Mayr's definition is accepted widely only in ornithology and is rejected in botany).

[85] MAYR II, *supra* note 63, at 273.

[86] *Id.* at 275. Because reproductive isolation fails as an effective criterion for asexual species, niche occupation is the critical factor in those limited situations. *Id.*

[87] *Id.* Isolating mechanisms occurring in nature that prevent mating are geographical isolation, temporal isolation (the populations mate at different times of the year), ethological isolation (potential mates may meet but do not mate because of different behavioral patterns). *See* Templeton, *supra* note 81, at 6. Postmating isolating mechanisms generally concern the inability of the mating to produce an offspring or the production of sterile or non-viable offspring. *Id.* at 6.

[88] MAYR II, *supra* note 63, at 284–85.

is a cross between a horse and a donkey.[89] Or, they may be viable and backcross with one or both of the parental species.[90] Sometimes, a hybrid zone may be created where the range of two species overlaps.[91] On rare occasions, there is a complete breakdown of isolating mechanisms and a hybrid swarm appears over the complete ranges of both parental species.[92]

An example of hybridization blurring the lines between species is available in the taxonomy of the Baltimore Oriole (*Icterus galbula*).[93] A handsome black and orange bird found in the eastern United States, the Baltimore Oriole is morphologically distinct from its western counterpart, the Bullock's Oriole (*Icterus bullocki*). The Great Plains separated the two birds for thousands of years. As orchards and suburbs were created in the Great Plains, however, the Baltimore Oriole's range expanded west as the Bullock's expanded east. Where the two met in western Oklahoma, western Kansas and central Nebraska they began to interbreed. In 1973 the American Ornithologists Union merged the two birds into one species, the Northern Oriole (*Icterus galbula*), to howls of complaints from Baltimore Oriole fans.[94]

Some taxonomists insist that the impossibility of producing fertile hybrids must be a defining characteristic of speciation,[95] and if it is possible for two organisms to create fertile offspring they must be the same species.[96] Most taxonomists concede, however, that while the inability to create fertile hybrids defines a line between species, the ability to create fertile hybrids does not automatically prevent a line from being drawn.[97] To try to make such a distinction based on potential hybridization is to fall back into a static view of speciation. As one treatise has noted: "Species do evolve, and almost always do so gradually. Among evolutionary species there cannot possibly be a general dichotomy between free interbreeding and not interbreeding. Every intermediate stage occurs, and there is no practical de-

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[89] MAYR III, *supra* note 79, at 70.

[90] *Id.* at 72.

[91] *Id.* Mayr gives the example of the Golden-winged Warble (*Vermivora chrysoptera*), whose zone intersects with the Blue-winged Warbler (*Vermivora pinus*) and creates two distinctive hybrids: Brewster's Warbler and Lawrence's Warbler. *Id.* Ornithologists have speculated that the two species were geographically isolated until fairly recently. *Id.* at 72–73.

[92] *Id.* at 73–76. A hybrid swarm occurs when individuals carrying genes of both parent species are found across the parent species' range. *Id.*

[93] *See generally* Arnold P. Baker, *Oriole Degraded*, WASH. POST, June 28, 1979, at 35.

[94] *Id.*

[95] SIMPSON, *supra* note 72, at 151.

[96] *See id.*

[97] *Id.* at 152.

finable point in time when two infraspecific populations suddenly become separate species."[98]

Because the organisms it classifies are themselves in flux, modern taxonomy[99] is a dynamic biological science, not an arbitrary system of classification to satisfy a museum curator's craving for order. Modern taxonomic classification is a theory about the evolutionary order of relationships among organisms.[100] An animal's or plant's proper classification depends upon its degree of relationship to other animals and plants.[101] Taxonomists recognize seven basic levels of increasing inclusion, from species (the fundamental unit of evolution), through genera, families, orders, classes, and phyla, to kingdoms.[102]

Taxonomists recognize only one formal category beneath the species, the subspecies.[103] Subspecies are distinct populations of a given species with unique identifying characteristics. The rule of thumb in determining a subspecies is: if you can distinguish 75% of the organisms of a given population from those of another there is a subspecies.[104] Subspecies differ from taxonomic classifications in two ways. First, they are categories of convenience: while each organism must belong to a species, a genus, a family and to all higher categories, a species need not be divided formally into subspecies.[105] Normally, subspecies represent a convenient way to report physical variation which is linked to geographic distribution. Second, the subspecies of any species cannot be reproductively isolated in any way other than geographic. Since all belong to a single species, their members must be able to reproduce with other individuals of the species.[106]

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[98] *Id.*

[99] There are in fact three rival schools in modern taxonomy: traditional or evolutionary methodology, numerical phenetics, and cladistics. MAYR II, *supra* note 63, at 221–35 (1982). The differences among these schools have great scientific debate. *See* Bayard Webster, *Classification is More Than A Matter of Fish or Fowl*, N.Y. TIMES, Feb. 14, 1982, § 4, at 8. This happily does not affect our discussion.

[100] SIMPSON, *supra* note 72, at 57.

[101] Part of the classification process is being able to place an organism in a dendrogram or phylogenetic tree. SIMPSON, *supra* note 72, at 62–63. These diagrams show the evolutionary interrelations of a group of organisms derived from a common ancestral form. *Id.* The ancestor is in the tree trunk; organisms that have arisen from it are placed at the ends of tree branches. *See generally id.* The distance of one group from the other indicates the degree of relationship. *Id.* at 51–54.

[102] For example: Kingdom—Animal; Phyla—*Chordata;* Sub-phyla—*Vertebrata;* Class—*Mammalia;* Order—*Primate;* Family—*Hominidae;* Genus—*Homo;* Species—*Homo sapiens.*

[103] MAYR II, *supra* note 63, at 289–92.

[104] SIMPSON, *supra* note 72, at 175–76.

[105] *Id.*

[106] STEPHEN JAY GOULD, EVER SINCE DARWIN 233 (1979).

The Act's protection of subspecies, as well as species, recently has come under attack.[107] Biologists, however, view subspecies as an important part of the natural process of evolution. A subspecies, isolated from other members of its species may, through genetic drift or mutation, develop into an independent species.[108]

The contemporary taxonomist has a wealth of modern technologies to assist in distinguishing species. The single most important of these is DNA analysis.[109] DNA is taken from the nucleus of the cell or from the energy producing organelles in the cell called mitochondria. Most analysis is done using the genes in mitochondrial DNA. They have the advantage over nuclear DNA that their simple set of thirteen genes is easier to study. Especially in cases where morphological analysis is ambiguous, comparisons of DNA can assist taxonomists in dividing species or determining a lack of division and degrees of relatedness.[110] Interestingly, morphological and genetic analysis do not always agree, thus raising the question as to how they should be used together.[111]

Despite the complexity of modern taxonomy, the drafters of the ESA and frequently the Fish and Wildlife Service seem to have a very simplistic view of what constitutes a species. Quite often, under the Act, species are treated as discrete entities under a traditional typological approach emphasizing physical characteristics. Thus, a species is defined if it has a particular kind of shape, size, color, or other attribute. The purpose of many endangered species programs was to preserve this particular snapshot of present day characteristics, ignoring the changes caused by evolutionary adaptation. This article will now examine two case studies that illustrate why this approach is unrealistic and counter-productive.

IV. "SPECIES" AS APPLIED UNDER THE ENDANGERED SPECIES ACT

A. The Problem of Canis Rufus

Normally, when people picture a wolf, whether to tell the tale of Little Red Riding Hood or read Farley Mowat, they mean the gray

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[107] The protection of subspecies became an issue when the construction of an observatory threatened a subspecies of the red squirrel (*Tamiasciurus husonicus grahamensis*). *Babblemouths*, WASH. POST MAG., Aug. 9, 1992, at W7. In response to the controversy, the Secretary of Interior asked "Do we have to save every subspecies?" *Id.*

[108] SIMPSON, *supra* note 72, at 221–22.

[109] MAYR II, *supra* note 63, at 236–37.

[110] *Id.*; *see also* Jan DeBlieu, *Could the Red Wolf Be a Mutt?*, N.Y. TIMES, June 14, 1992, at § 6, 30.

[111] *See* DeBlieu, *supra* note 110, at § 6, 30.

wolf (*Canis lupus*), also known as the timber wolf or tundra wolf. The gray wolf is found world wide and has a distinct presence in popular culture. The species is a member of the *Canidae* family of the order *Carnivora* of the class *Mammalia.*[112] Other members of the *Canidae* family include the domestic dog (*Canis familiaris*) and the coyote (*Canis latrans*). A possible additional member of the family is the red wolf (*Canis rufus*). There are no fairy tales told about the red wolf, except perhaps that it exists as a distinct species.

The animal frequently classified as *Canis rufus* is about the size of a large dog. Weighing from forty to eighty pounds, *rufus* falls roughly between the size of the gray wolf and the smaller coyote.[113] Historically, the red wolf inhabited a belt stretching east from North Carolina to Texas and south from the Gulf of Mexico to southern Illinois.[114] By the mid-1970's, *rufus* was virtually extinct in the wild due primarily to trapping and habitat destruction.[115]

The Fish and Wildlife Service began to trap the remaining specimens in an attempt to preserve some of the wolves for captive breeding.[116] According to the World Wildlife Fund, the recovery plan developed was the first ESA recovery plan and has served as a model for subsequent programs.[117] The captive breeding project has resulted in the reintroduction of the animal in North Carolina as well as some of the gulf islands.[118]

The taxonomic status of the red wolf is an open question. Biologists have noted four taxonomical anomalies: the wolf was found in a very

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[112] L. DAVID MECH, THE WOLF: THE ECOLOGY AND BEHAVIOR OF AN ENDANGERED SPECIES 20–22 (1970).

[113] WORLD WILDLIFE FUND GUIDE TO ENDANGERED SPECIES 448 (1990) [hereinafter WORLD WILDLIFE FUND].

[114] Fish and Wildlife Service, Endangered and Threatened Wildlife and Plants; Determination of Experimental Population Status for an Introduced Population of Red Wolves in North Carolina and Tennessee, 56 Fed. Reg. 56,325, 56,326 (1991) (to be codified at 50 C.F.R. pt. 17).

[115] Douglas H. Plimlott & Paul W. Joslin, *The Status and Distribution of the Red Wolf in* Thirty-Third North American Wildlife Conference 385 (1975). Farmers and ranchers viewed *rufus* as a threat to livestock, particularly calves. *Id.* As a result, there were systematic efforts to eliminate the species in farming areas. *Id.* One trapper working in southeastern Texas killed fifty-two wolves in one year. *Id.* Three years later the population was so reduced in the area that only eight were killed. *Id.*

[116] Fish and Wildlife Service, *supra* note 114, at 56,327.

[117] WORLD WILDLIFE FUND, *supra* note 113, at 449.

[118] The Fish and Wildlife Service has expended considerable time and energy on the recovery plan for *rufus*. *Id.* at 449–50. Originally selected animals were to be released in Tennessee and Kentucky but public opposition scuttled the plan. *Id.* Four pairs of the wolves were finally introduced in North Carolina after an extensive public education program. *Id.*; *see generally* Vic Banks, *The Red Wolf Gets a Second Chance to Live by Its Wits: Seeding a Carolina Refuge with Pairs Bred in Captivity*, 18 SMITHSONIAN MAG. 100 (Mar. 1988).

narrow geographic range; it was the only wolf in the world that was not a subspecies of *Canis lupus;* its range overlapped with both *Canis lupus* and *Canis latrans*, and where its range overlapped with *Canis lupus* it physically resembled *Canis lupus* but where its range overlapped with *Canis latrans* it resembled *Canis latrans*.[119] Four possible taxonomic solutions are possible. The red wolf could be a full species, or it could be a subspecies of the gray wolf, or a subspecies of the coyote or a hybrid between the gray wolf and the coyote.[120]

When the red wolf was first described in 1851 it was classified as a subspecies of *Canis lupus*.[121] Subsequent zoologists attempted to classify various geographic populations of the red wolf as two distinct species.[122] The small wolf found in Texas and the south central United States was known as *Canis rufus* while the wolf found in Florida and the southeast was known as *Canis ater* and later *Canis floridanus*.[123] In 1937, however, the wolves of the southeastern and south central United States were combined into the species that became known as *Canis rufus*.[124]

This classification was not without controversy. A 1967 study compared skulls of *Canis rufus* with those of *Canis familiaris*, *Canis latrans*, and *Canis lupus* and concluded that *Canis rufus* "east of the range of *Canis latrans*, are a local form of *Canis lupus*, not a distinct species of wolf."[125] This attack seemed to be countered successfully when Ronald Nowak of the Fish and Wildlife Service pub-

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[119] *See* Barbara Lawrence & William H. Bossert, *Multiple Character Analysis of* Canis lupus, latrans *and* familiaris, *with a discussion of the Relationships of* Canis niger, 7 ZOOLOGIST 223, 227 (1967).

[120] *See id.* at 227–28.

[121] JAMES T. AUDUBON ET AL., THE VIVIPAROUS QUADRUPEDS OF NORTH AMERICA, 254–56 (1851). In fact they describe the animal now classified as the red wolf as two distinct subspecies of gray wolf. John L. Gittleman & Stuart L. Pimm, *Crying Wolf in North America*, 351 NATURE 524, 524 (June 13, 1991). It should be noted that 1851 is a rather late recognition for a major predator. *Id.* John L. Gittleman & Stuart L. Pimm in their article *Crying Wolf in North America*, use this as one argument against classifying the red wolf as a distinct species. *Id.* at 524–28.

[122] *See* RONALD M. NOWAK, NORTH AMERICAN QUATERNARY CANIS: MONOGRAPHY THE MUSEUM OF NATURAL HISTORY, UNIV. OF KANSAS 24–26 (1979).

[123] *Id.* at 25.

[124] E.A. Goldman, *The Wolves of North America*, 18 J. OF MAMMALOGY 37, 44 (1937). The scientific name for the red wolf has a confusing history. While Goldman named the species *Canis rufus*, it was known from 1944 to 1967 as *Canis niger* with three subspecies: *Canis niger niger, Canis niger gregoryi* and *Canis niger rufus*. Plimlott and Joslin, *supra* note 115, at 377. Since 1967, the species has been known as *Canis rufus* with the subspecies of *Canis rufus floridanus, Canis rufus gregoryi* and *Canis rufus*. *Id.*

[125] Lawrence & Bossert, *supra* note 119, at 229.

lished a superb treatise which seemed to establish a clear paleontological and historical record for *Canis rufus* as a distinct species.[126] Nowak's classic morphological analysis was based on hundreds of fossils and museum samples of North American *Canis*.

Despite Nowak's remarkable study, the status of *Canis rufus* is far from resolved. A 1991 study comparing mitochondrial DNA samples taken from a captive breeding colony of *Canis rufus* and samples taken from wild red wolves in the 1970's with samples taken from 327 coyotes and 276 gray wolves came to the conclusion that the red wolf's mitochondrial DNA was very similar to that of coyotes.[127] This fact alone does not eliminate the possibility of the red wolf being a distinct species because a declining species may hybridize as a desperate strategy to reproduce.[128] To check for this possibility the researchers examined six museum pelts of red wolves collected from 1905 to 1930. They compared samples of the DNA sequence from these pelts with samples taken from gray wolves and coyotes. While the DNA sequences obtained were distinct for the gray wolves and coyotes, those for the red wolves typed as either coyotes or gray wolves.[129] The strength of Wayne and Jenks's study is in using both morphological data and a combination of current and historical samples for genetic analysis.[130]

Although it is probably premature to come to a conclusion as to whether the red wolf is a separate species, the red wolf's status as a distinct species appears to be increasingly unlikely. The species classification always has been suspect on classic morphological grounds and has now been undermined by DNA testing.

Yet, it is not clear that the red wolf is simply a hybrid. It may be a subspecies of the gray wolf which would explain why it does not have a distinct genetic profile.[131] Or perhaps the red wolf was a unique species that was so reduced by trapping and habitat destruction, prior to the pelts studied by Wayne and Jenks, that the remnant population was forced to crossbreed with gray wolves and coyotes.

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[126] *See generally* NOWAK, *supra* note 122.

[127] R.K. Wayne & S.M. Jenks, *Mitochondrial DNA Analysis Implying Extensive Hybridization of the Endangered Red Wolf* Canis rufus, 351 NATURE 565 (1991).

[128] Gittleman & Pimm, *supra* note 121, at 324.

[129] Wayne & Jenks *supra* note 127, at 566.

[130] Gittleman & Pimm, *supra* note 121, at 524–25.

[131] Wayne & Jenks indicated that it was unlikely that the red wolf was a subspecies of the gray wolf: "Arguing against red wolves constituting a distinct subspecies, are the probable high rate of gene flow from adjacent populations of gray wolves living in similar habitats that would tend to obliterate the distinctive morphology of the red wolf subspecies." Wayne & Jenks, *supra* note 127, at 566.

As the last example of an extinct species the red wolf would be worth saving despite its hybridization.

Clearly the Act's failure to adequately define species has placed conservation biologists in a quandary. If the red wolf is not a distinct species, it will not receive protected status and federal funds cannot be used to reintroduce the animals into the wild.[132] There exists a possibility that the red wolf contains genetic stock from an earlier species of wolf or is a subspecies of wolf that has extensively hybridized. Should this genetic heritage be saved? Under the old hybrid policy the answer would be no.[133] But that policy changed about the same time as the DNA studies of the red wolf. The answer today is unclear but it will have to be made with the realization that there are limited funds to preserve endangered species.

The difficulty of classifying the red wolf is not unique. Ambiguity is inherent in the taxonomic classification of endangered species. Two biologists, Gittleman and Pimm, have noted that "bad taxonomy can kill when distinct species are not afforded specific status."[134] But, it is also true that where limited resources are available to protect and conserve endangered species the misallocation of funds to support an animal mistakenly classified as a species may also kill. If there is no biological justification for conserving the red wolf the Fish and Wildlife Service has wasted funds that could have been spent to protect and conserve other species.

B. The Sad Story of The Dusky Seaside Sparrow

The Seaside Sparrow (*Ammospiza maritima*) is a small, somewhat drab, retiring bird found in coastal marshes from Massachusetts down the Atlantic and Gulf coasts as far as South Texas.[135] The species is divided into nine subspecies. One of these subspecies, the Cape Sable (*Ammospiza maritima mirabilis*), is listed as endangered[136] and another, the Dusky (*Ammospiza maritima nigrescens*) is considered extinct.[137] The Department of the Interior's hybrid policy is one reason the bird is extinct.

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[132] *See* discussion *supra* part II(B).

[133] *Id.*

[134] Gittleman & Pimm, *supra* note 121, at 524.

[135] Oliver L. Austin, *The Seaside Sparrow Assemblage: A Review of Its History and Biology, in* THE SEASIDE SPARROW: ITS BIOLOGY AND MANAGEMENT 153 (1983) (Proceedings of Symposium held at Raleigh, North Carolina 1–2 October 1981) [hereinafter SEASIDE SPARROW SYMPOSIUM].

[136] 50 C.F.R. § 17.95 (1991).

[137] 55 Fed. Reg. 51,112 (Dec. 12, 1990).

The Dusky Seaside Sparrow was distinguished from other subspecies of seaside sparrow by its dark coloration and a distinct song.[138] Geographically isolated from other seaside sparrows, the subspecies was found in the marshes of Florida's Atlantic Coast on Merrit Island and the upper St. Johns River.[139]

The taxonomic history of the Dusky is almost as confusing as that of the red wolf. The bird was first described in 1873 and categorized as a full species.[140] It was not until 1973 that it was reduced to subspecies status under the Seaside Sparrow.[141]

Subsequently, researchers found that the Dusky's mitochondrial DNA was indistinguishable from the mitochondrial DNA of other Seaside Sparrow populations.[142] This similarity indicated that the Dusky did not have a distinct genetic lineage and raised questions as to whether the Dusky should even be considered a subspecies. DNA testing by itself, however, does not demonstrate that subspecies classification is undeserving.[143] The Dusky's distinct morphological characteristics combined with its geographical isolation amply support its designation as a subspecies.

The Fish and Wildlife Service first listed the Dusky as endangered in 1967 under the predecessor to the current Act.[144] Shortly after this listing the Dusky began a precipitous decline. From an estimated population of 1800 in 1968, the Dusky slid to just five individuals—all males—by 1981.[145] The difficulty of conserving a species that had no females is obvious but an interesting proposal for a captive breeding program was proposed, by biologists from the Florida State Museum.[146]

The five remaining male Duskies could be bred with females of another subspecies of the Seaside, the Scott's Seaside Sparrow (*Ammodramus maritimus peninsulae*).[147] The plan was for the male Duskies to be bred with this morphologically similar subspecies. The hybrid offspring would be half Dusky. Female hybrids would then

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[138] *Id.*

[139] *Id.*

[140] *Id.*

[141] *Id.*

[142] John C. Avise & William S. Nelson, *Molecular Genetic Relationships of the Extinct Dusky Seaside Sparrow*, 243 SCIENCE 646 (Feb. 1989).

[143] *See id.* at 648.

[144] 32 Fed. Reg. 4001 (1967); *see* 50 C.F.R. § 10.13 (1991).

[145] Thomas A. Webber & William Post, *Breeding Seaside Sparrows in Captivity*, *in* SEASIDE SPARROW SYMPOSIUM, *supra* note 135, at 153.

[146] *Id.*

[147] *Id.* at 154.

be "back-crossed" to the Dusky males. By progressively back-crossing each generation the hybrids would move toward being pure Duskies. By the sixth generation, the offspring would be 98.4% Dusky and virtually indistinguishable from pure Duskies.[148]

Initial efforts at crossbreeding the remnant Dusky population with its sibling subspecies were very successful.[149] In describing the experiment, Webber and Post optimistically noted, "In fact, the fifty-percenters look so much like duskies that it may well take only two or three generations of backcrossing, rather than the usually cited six, to produce offspring indistinguishable from duskies."[150]

Unfortunately, although the Fish and Wildlife Service initially supported the crossbreeding program, it withdrew its support due to Interior's hybrid policy.[151] By the time private parties could continue crossbreeding, the whole effort had unraveled.[152] Because of the advanced age of the birds, the privately supported program quickly failed. In 1987, the last of the Dusky males died of natural causes.[153] Within two years, all of the hybrid offspring had died or been lost by accident.[154]

The Fish and Wildlife Service's decision to terminate the crossbreeding program was the result of bad, or at least obsolete, taxonomic analysis combined with questionable legal analysis.[155] The reasoning of the legal opinion demonstrated an almost platonic fixation on species as a fixed and immutable concept. A Dusky is a Dusky and the offspring of a Dusky and another sparrow cannot be a Dusky, nor can its offspring or its offspring's offspring be a Dusky no matter how many generations are backcrossed with pure Duskies.

There may have been some economic justification for declining to award further federal funds to save what was at best a marginal

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[148] Mann & Plummer, *supra* note 51, at 58.

[149] Webber & Post, *supra* note 145, at 161.

[150] *Id.* "Fifty-percenter" refers to the genetic relatedness of the offspring to the purebred parents. *Id.*

[151] Mann & Plummer, *supra* note 51, at 58.

[152] *Id.*

[153] *See* 55 Fed. Reg. 51,113.

[154] *Id.* It is more difficult to keep wild birds alive in a captive setting conducive to breeding than it may first appear. The birds must be kept outside in large aviaries. As a result they are subject to abuse from storms, and can be preyed on by cats, raccoons and rats who are clever enough to get into the cages. Small birds such as the Dusky can escape through any crack or opening. If a storm tears the wire mesh, the birds quickly escape, perhaps never to be recaptured. This author, who has been involved in breeding programs for endangered raptors, can only sympathize with the Duskies' last keepers.

[155] *See* Memorandum of May 6, 1981, *supra* note 50, at 1.

subspecies.[156] But the logic used to support the Solicitor's decision is not persuasive. The Solicitor advanced three justifications for the hybrid policy. First, the production of hybrids would disrupt the gene pool of the endangered parent species.[157] Second, hybrids released to the wild might compete with the endangered parent species.[158] Third, the protection of hybrids was contrary to Congress' intent "to preserve the genetic purity and diversity of disappearing species."[159] As applied to the Dusky, the first two arguments are inappropriate. The lack of any breeding population in the wild means that there cannot be any threat that the hybrids will dilute the gene pool or displace the parent population. The third justification, however, deserves to be addressed because its assumptions go to the heart of the problem.

In an earlier opinion letter on the hybrid issue the Solicitor relied on a quote taken from the House Report on the Act. "The value of . . . genetic heritage is, quite literally, incalculable. The blue whale evolved over a long period of time and the combination of factors in its background has produced a certain code, found in its genes, which enables it to reproduce itself, rather than producing sperm whales, dolphins, or goldfish."[160] The Solicitor went on to comment: "It appears that Congress was concerned that specimens of a species be able to interbreed among themselves, and not with members of other species so as to produce the remotely related progeny which occur in [subsequent] generations of hybrids."[161]

The Solicitor's statement has demonstrable weaknesses. First, it has an unrealistic expectation of precision in delineating species. As we have seen, the taxonomic status of the Dusky has hardly been consistent. From full species designation it was relegated to a subspecies. Questions were later raised as to whether it deserved any special categorization. The Dusky is hardly unique in this regard, as ornithological classifications frequently shift. The Solicitor envisioned a precision present in neither nature nor taxonomy.

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[156] Reportedly, the federal government had already spent over $2.6 million securing habitats for the Dusky. Mann & Plummer, *supra* note 51 at 56–58. The Fish and Wildlife Service did not just withdraw funding, however, for two years it prohibited any private attempts at crossbreeding. *Id.*

[157] Memorandum of May 6, 1981, *supra* note 50, at 2.

[158] *Id.*

[159] *Id.*

[160] Memorandum of Aug. 2, 1977, *supra* note 43, at 3 (*quoting* H.R. Rep. No. 93–412, 93rd Cong., 1st Sess., 4 (1973)).

[161] *Id.*

For birds, with 9,672 species and thousands of subspecies, taxonomic ambiguities are especially problematic.[162] First, hybridization between species is particularly prevalent. One recent study estimates that 9.2% of species are known to have bred in nature with another species and produced hybrid offspring.[163] This hybridization may be an important evolutionary mechanism in the development of new species.[164] It may occur at an even higher frequency among endangered species where mates are scarce. Viewed in this light, there is a certain irony in the hybridization policy—those species that most need protection under the Act are most likely to hybridize.

Second, the Solicitor's reasoning did not fit the Dusky's unfortunate predicament. If the intent of Congress was to preserve the genetic codes of endangered species, the only way the constellation of genes that we knew as the Dusky Seaside Sparrow could have been preserved was by crossbreeding and backcrossing. The result would have been a bird that was morphologically identical to the Dusky and contained 98.4% of the Dusky's genetic code. Presented with the choice of a 98.4% pure Dusky or none at all, the Solicitor chose extinction. To save an abstraction of the species, the reality was allowed to die.

V. A New Definition of Species

The Endangered Species Act is currently up for reauthorization by the 102nd Congress. As of this writing, four bills have been introduced to amend the Act, each with distinct variations.[165] None of the bills effectively address with the definitional problem of species or the status of hybrids.

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[162] Peter R. Grant & Rosemary Grant, *Hybridization of Bird Species*, 256 Science 193, 194 (1992).

[163] *Id.*

[164] *Id.* at 197.

[165] H.R. 4045 would reauthorize the ESA and strengthen protection of endangered species. H.R. 4045, 102nd Cong., 2d Sess. (1991). H.R. 4058 amends the Act to balance economic and environmental considerations by requiring an economic impact analysis before any federal action is taken to conserve a threatened or endangered species. H.R. 4058, 102nd Cong., 2nd Sess. (1991). H.R. 3092 amends the Act so that species would not be protected if the economic benefits of the protection do not outweigh the costs. H.R. 3092, 102nd Cong., 2nd Sess (1991). H.R. 5105 amends the Act to require an economic analysis of listing a species on local and regional economies and a cost-benefit analysis of the probability that a species will recover. H.R. 5105, 102nd Cong., 2nd Sess. (1992). The bill would also streamline the exemption process involving the Endangered Species Committee to allow the continuation of development projects and relief to workers. *Id.*

The treatment of hybrids came under intense attack from scientific circles in March 1991. Ernst Mayr, a celebrated biologist, and Stephen J. O'Brien, a molecular biologist, pointed out that hybridization between subspecies was a natural process that was disrupted by denying protection to organisms with mixed pedigrees.[166] Therefore, they suggested that hybridization should not diminish the protections granted endangered subspecies.[167] They suggested that while discouraging hybridization between species was appropriate in most cases with severely threatened species, hybridization might be necessary to preserve the organism's genetic heritage.[168]

O'Brien and Mayr's suggestions provide a good starting point for the revisions that are necessary in the Act. The Act cannot treat the concept of species as a snapshot of a particular moment to be preserved for all time. All biological entities are constantly adapting and changing to meet the environmental flux around them.

Moreover, the science of classifying these organisms is incapable of the precision and constancy that administrators of the Act have required. Too often lawyers look to science for a precision that is lacking in their own discipline; failing to grasp that science advances by fits and starts punctuated by a significant amount of critical inquiry. Science, by and large, works on a falsification basis.[169] After a hypothesis is put forward, it is examined critically by the scientific community. Even once a consensus of specialists in the field accept the hypothesis, new information may result in the position being overthrown.

The confusion over the species status of the red wolf is an example of this process.[170] First classified as a subspecies of the gray wolf, further studies resulted in its reclassification as three separate species that were ultimately combined into one species. Now, further information indicates that it may not be a species after all, and perhaps not even a subspecies. This process, not unusual in biology or any of the sciences, does not support bright line decision making.

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[166] Stephen O'Brien & Ernst Mayr, *Bureaucratic Mischief: Recognizing Endangered Species and Subspecies*, 251 SCIENCE 1187, 1187–88 (1991).

[167] *Id.* at 1188.

[168] *Id.* at 1188 n.18.

[169] According to Karl Popper, science advances by means of a continuous process of conjecture and refutation. Hypotheses are formulated and tested by observation and experiment. If the hypothesis is not corroborated, it must be modified or abandoned. Hypotheses may sometimes be disproved, but there is no logical procedure by which a hypothesis can be proved true. *See* KARL POPPER, CONJECTURES AND REFUTATIONS 33–65 (1963).

[170] *See supra* part IV.A.

Any modification of the Act that will result in a more scientifically accurate treatment of species must require a careful case-by-case scrutiny and allow room for considerable exercise of judgment. The definition of species one accepts has a profound impact on determining what one can and ought to do to save an endangered species. If the Act is meant to do more than just protect charismatic megafauna who are valued for their sentimental appeal, the definition of species must reflect the need to protect biodiversity. Thus, the species definition should include a requirement that the organism fill a specific ecological niche.

The second, and probably more important requirement is that the Act should define a species as a lineage that shares a common evolutionary fate. The only definition that meets both requirements is Mayr's Biological Species Concept: "A species is a reproductive community of populations (reproductively isolated from others) that occupies a specific niche in nature."[171] This is not the ideal definition of species for all purposes, but it does emphasize that species are not static entities, and that the characteristics that define the present day populations of a species are characteristics that may evolve.

If the Act is understood as preserving unique evolutionary lines rather than a snapshot of present day traits that we call a species, hybridization would be viewed as a beneficial management tool rather than a deleterious situation that must be prevented.[172] Because species are evolutionary, the Act should not ignore or try to suppress change in all circumstances. Instead, the Act should use evolutionary change for the preservation of endangered genetic heritages.

VI. CONCLUSION

The 1992 federal budget allocated $50.5 million for the management and protection of more than 650 endangered and threatened species.[173] The Fish and Wildlife Service and National Marine Fisheries Service recognize that another 600 species deserve to be listed as either threatened or endangered but remain unprotected because of administrative delays.[174] In addition, more than 3,000 petitions to

[171] MAYR II, *supra* note 63, at 273.

[172] This is not to suggest that conservationists should intervene extensively by hybridizing endangered species. Other than ensuring that genetic variation is preserved and running captive breeding hybridization projects for the most severely threatened species (such as the Dusky Seaside Sparrow project), the Act should allow as little intervention as possible.

[173] G.A.O., *supra* note 2, at 9, 25.

[174] *Id.* at 2.

list species as threatened or endangered remain pending.[175] Because there are limited funds to protect and manage so many species, taxonomic decisions have real world implications for the survival of animals. Decisions to list species as endangered or threatened based on bad taxonomy can result in the waste of these limited resources. Similarly, when a species is denied protection because of bad taxonomy, the ESA has failed in its mandate to protect the nation's wildlife.

The failure of Congress to provide an appropriate scientific definition of species in the ESA has led to bungled handling of at least two species. The Dusky Seaside Sparrow is not extinct because of qualms about hybridization and funds appear to have been wasted on a non-species, the red wolf. To avoid similar problems in the future, the ESA should be amended to include the Biological Species Concept as the definition of species.

The Biological Species Concept will not make the task of administering the ESA any easier. It does not lend itself to simple, bright-line decision making, but it does offer the opportunity for a more accurate assessment of when an animal should be provided with the protections of the ESA.

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[175] *See id.*