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Transgenic Salmon and the Definition of "Species" Under the Endangered Species Act

by

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TRANSGENIC SALMON AND THE DEFINITION OF "SPECIES" UNDER THE ENDANGERED SPECIES ACT

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I. INTRODUCTION

Advances in biotechnology during the late Twentieth Century have enabled scientists to manipulate their environment in an unprecedented manner for purposes including development of new drugs and new types of food.[1] Specifically, scientists can use biotechnology to engineer or genetically modify living organisms to incorporate DNA representing some desirable trait from one organism into another that will exhibit the desirable trait. One contemporary and particularly controversial product of biotechnology is the genetically modified or transgenic salmon. As one company engineers them, transgenic salmon are composed of Atlantic salmon that have incorporated both a gene that produces

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1. *See* David F. Betsch, *Principles of Biotechnology*, North Central Regional Extension Publications, Biotechnology Information Series, *at* http://www.nal.usda.gov/bic/Education_res/iastate.info/bio1.html (March 1994).

growth hormones and a promoter gene that activates the first gene.[2] Proponents of these unique fish tout them as a potentially efficient and economical source of food. Opponents raise concerns not only about how safe these fish are for human consumption but also about the environmental risks in raising them. One study in particular cautioned that if transgenic salmon were raised in an aquaculture environment and somehow escaped into the wild, they could force natural populations into extinction due to the combined effect of their increased mating advantage and decreased survivability.[3]

The Endangered Species Act of 1973 ("ESA")[4] may provide some solutions as well as problems relating to the issue of transgenic salmon. The ESA's protections extend only to "species" as administrative agencies and courts have interpreted that term. Section 1532 of the ESA defines "species" to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature."[5] On the one hand, then, the ESA should protect already endangered or threatened wild species from any dangers that transgenic salmon pose. On the other hand, though, the ESA can only protect wild populations of salmon from transgenic ones if its legal framework provides the agencies with a basis for distinguishing between them. At the heart of any basis for distinguishing between organisms under the ESA is the definition of "species."

This comment examines the many scientific definitions of "species" to determine the status of transgenic salmon within modern taxonomy. Additionally, the comment examines the many and equally complex legal definitions of "species" under the ESA. Applying both the scientific and legal standards, the comment explores whether transgenic salmon are, or, if not, should be a separate species under the ESA. Consequently, the comment also answers the questions of whether non-transgenic salmon could be protected against transgenic escapees and whether the ESA could somehow extend its protections to transgenic salmon themselves.

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2. *See* Anne Kapuscinski, *Biosafety Assessment of Transgenic Aquatic Organisms: The Case of Transgenic Salmon, in* AQUACULTURE AND THE PROTECTION OF WILD SALMON 56, 57 (Patricia Gallaugher & Craig Orr eds., 2000), *available at* http://www.sfu.ca/cstudies/science/aquaculture/Aquacultureproceedings.pdf (last visited Nov. 6, 2002); Aqua Bounty Farms, *The Research, at* http://www.aquabounty.com/research.html (last visited Nov. 6, 2002).

3. *See* William M. Muir & Richard D. Howard, *Possible ecological risks of transgenic organism release when transgenes affect mating success: Sexual selection and the Trojan gene hypothesis*, 96 PROC. NAT'L ACAD. SCI. U.S. AM. 13853, 13853-56 (1999).

4. 16 U.S.C. §§ 1531-1544 (2000).

5. *Id.* § 1532(16).

Part II traces the biological definitions of "species" throughout history from the morphology-based essentialist views to Ernst Mayr's generally accepted Biological Species Concept ("BSC"). Given these various views, I conclude that even within the scientific community the definition of "species" is quite fluid.

In exploring the legal definitions of "species," Part III begins with an analysis of the ESA's language itself. After reviewing both precursor statutes and the language currently in effect, I contend that a tension exists in the ESA between a mandate that decisions to list species be based only on scientific data and the Act's thoroughly unscientific definition of "species." Ultimately, the statutory analysis reveals a desire to preserve genetic diversity and heritage. Part II then examines the administrative explications of the ESA. The listing agencies'[6] definitions of "distinct population segment" ("DPS") demonstrate ambivalence about the type and quality of difference between organisms of the same species required for protecting separate populations. Yet the FWS and NMFS suggest in their proposed policy on hybridization that they would not protect transgenic fish unless they were a part of an approved recovery plan.[7] Finally, Part II examines the sparse judicial interpretations of "species." While stating little directly on point, the courts have recognized that the ESA definition of "species" is broader than the usual scientific definition. Additionally, though courts generally defer to agencies on issues of science, a recent case has reined in an agency that attempted to split hairs too finely in a listing decision based on distinctions below the level of subspecies or DPS.[8]

Part IV closely analyzes the status of transgenic salmon. It starts with an explanation of the biology behind genetically engineered fish. Next, Part IV reviews federal policy on the types of aquaculture environments in which transgenic salmon may be raised. I also include a summary of one scientific prediction about the dangers that aquaculture-raised transgenic salmon pose to the environment. Finally, Part V concludes this comment with a consideration of transgenic salmon as a species under the ESA by

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6. *See id.* § 1532(15) (defining "Secretary" to mean the Secretaries of Interior and Commerce). The National Marine Fisheries Service ("NMFS") carries out the ESA duties for the Secretary of Commerce while the Fish and Wildlife Service ("FWS") carries out the Secretary of Interior's duties. *See* J.B. Ruhl, *The Endangered Species Act, in* ENVIRONMENTAL ASPECTS OF REAL ESTATE TRANSACTIONS 640, 643 (James B. Witkin ed., 1st ed. 1995).

7. *See* Endangered and Threatened Wildlife and Plants; Proposed Policy and Proposed Rule on the Treatment of Intercrosses and Intercross Progeny (the Issue of "Hybridization"), 61 Fed. Reg. 4,710, 4,710 (Feb. 7, 1996) (to be codified at 50 C.F.R. pt. 424) [hereinafter Proposed Hybrid Policy].

8. *See* Alsea Valley Alliance v. Evans, 161 F. Supp. 2d 1154, 1162 (D. Or. 2001).

applying the biological and legal standards to transgenic salmon in hypothetical but realistic situations.

Ultimately, there may be a simple answer to the question of whether transgenic salmon are "species" under the ESA. The proposed hybrid policy clearly and wisely would deny protection. In the absence of this policy, the answer depends on many variables, including the degree of genetic and morphological difference between transgenic and natural organisms, as well as the actual situation of actual transgenic populations and their relationship to natural populations. Yet given the indication of the agencies' mindset on transgenic organisms, transgenic salmon probably will not and should not warrant "species" status under the ESA.

II. SCIENTIFIC DEFINITIONS OF "SPECIES"

Since the ESA uses many scientific terms, and since the ESA often explicitly requires agencies to consider scientific data,[9] understanding the scientific use of certain terms may help determine how the designation "species" applies to transgenic organisms. Unfortunately, while young biology students may memorize the apparently fixed taxonomic categories and recite erudite-sounding Latin nomenclature, biologists still disagree on the substantive definition of "species."[10] The scientific consensus on "species," then, is that no complete consensus exists and that different definitions suit different purposes.

A. *Taxonomy Generally*

Taxonomy refers to the discipline of recognizing and delimiting groups of organisms and arranging them into a classification scheme.[11] More precisely, categories are the abstract class names into which organisms are placed.[12] An eighteenth century Swedish biologist named Carl Linnaeus, the "father of taxonomy,"[13] developed the familiar system of hierarchical categories consisting of Kingdom, Class, Order, Genus, and Species.[14] According to

9. *See, e.g.*, 16 U.S.C. § 1533(b)(1)(A) (2000) (requiring the secretary to make determinations regarding the listing of endangered or threatened species "solely on the basis of the best scientific and commercial data").

10. *See* John Charles Kunich, *The Fallacy of Deathbed Conservation Under the Endangered Species Act*, 24 ENVTL. L. 501, 505 (1994) (stating that the very validity of the concept of species is debatable).

11. ERNST MAYR, THE GROWTH OF BIOLOGICAL THOUGHT: DIVERSITY, EVOLUTION, AND INHERITANCE 146 (1982).

12. ERNST MAYR, POPULATIONS, SPECIES, AND EVOLUTION: AN ABRIDGMENT OF ANIMAL SPECIES AND EVOLUTION 13 (1970).

13. MAYR, *supra* note 11, at 171.

14. Kevin P. Hill, *The Endangered Species Act: What Do We Mean by Species?*, 20 B.C.

Linnaeus's Latin multinomial system, organisms are identified by their genus and species names. Genus refers to organisms with a certain affinity such as dogs (*Canis*); species refers to a distinguishing character between groups in the genus such as that distinguishing domestic dogs (*Canis familiaris*) from wolves (*Canis lupus*).[15]

Taxonomists do not classify organisms as individuals but rather as groups, which, if they are sufficiently distinct, form taxa.[16] Taxa are thus groups of actual organisms that are assigned to specific categories.[17] Historically, the process of classifying organisms into the species category by determining whether given groups are sufficiently distinct has turned on two basic criteria: (1) morphology, or observable differences in appearance and form, and (2) sexual compatibility, or the actual and potential ability of groups to interbreed and produce viable offspring.[18] Though the history of biology has included many definitions of species, they all seem to oscillate between these two factors.

At a very basic level, then, the traditional framework for categorizing groups of organisms as distinct species underlies any agency decision to list a species. General taxonomy provides some of the nomenclature for listing decisions and likely serves as the agencies' background cognitive conception of the animal kingdom. As the ESA's title suggests, however, listing decisions are concerned only with the species category.

B. Differing Views on "Species"

Though scientists debate the definition of "species," today they generally accept one model, Ernst Mayr's biological species concept ("BSC"),[19] as the default standard.[20] The BSC makes sense, however, only in light of prior theories. The BSC represents a product of historical dialectic by synthesizing previously divergent ideas into one definition. In past definitions one finds the elements composing the current standard.

ENVTL. AFF. L. REV. 239, 247-48 (1993).

15. *Id.* at 248.

16. MAYR, *supra* note 12, at 14.

17. *Id.*

18. Holly Doremus, *Listing Decisions Under the Endangered Species Act: Why Better Science Isn't Always Better Policy*, 75 WASH. U. L.Q. 1029, 1089 (1997).

19. *See* Stephen J. O'Brien & Ernst Mayr, *Bureaucratic Mischief: Recognizing Endangered Species and Subspecies*, 251 SCI. 1187, 1187-88 (1991) (providing a general overview of the BSC).

20. *See* Hill, *supra* note 14, at 250.

1. The Essentialist Views

The earliest species concepts, including that of Linneaus,[21] up to the time of Darwin can generally be referred to as essentialist concepts.[22] Also called typological concepts,[23] these views categorize organisms solely using morphology as the determinative criterion. The essentialist views have four basic characteristics: "(1) species consist of similar individuals sharing in the same essence; (2) each species is separated from all others by a sharp discontinuity; (3) each species is constant through time; and (4) there are severe limitations to the possible variation of any one species."[24] The guiding precept of essentialism is that groups of organisms sharing some observable trait correspond to a platonic ideal;[25] the members of each group share or participate in the same fixed essence, and each member represents a particular spacio-temporal expression of that species-essence.

The practical effect of an essentialist model is to view the animal kingdom as organized into a system of neat pigeonholes.[26] Taxonomy therefore consists of the obviously simple task of observing animal populations, noting groups that look alike, and metaphorically placing the groups into different species-essence pigeonholes. Of course, essentialists encountered a little problem when they observed the vast amount of variation between basically similar organisms.[27] Yet according to platonic metaphysics, nothing in the realm of space and time perfectly expresses perfect ideals; variation must, then, simply represent imperfect manifestations of a platonic ideal.

The predominance of essentialist views in western biology makes sense given its convenient compatibility with creationist dogma involving finite kinds of creatures created at one time.[28] Also, using morphology as the criterion is simple and requires no real technical skill. Essentialism was popular probably because it appealed to a sense of truth in simplicity. Indeed, even today, listing agencies rely a great deal on morphological differences in distinguishing between organisms.[29]

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21. *See* MAYR, *supra* note 11, at 258.
22. *See* Doremus, *supra* note 18, at 1089.
23. *See* MAYR, *supra* note 12, at 11.
24. MAYR, *supra* note 11, at 260.
25. *See id.*
26. Hill, *supra* note 14, at 248.
27. *See id.* at 249; MAYR, *supra* note 12, at 11.
28. *See* MAYR, *supra* note 11, at 257.
29. Doremus, *supra* note 18, at 1112.

2. The Effect of Darwin's Theory of Evolution

With the publication in 1859 of his *Origin of Species*, Charles Darwin rejected the static worldview of the essentialists.[30] Instead, Darwin's theory of evolution maintained that species continuously mutate into new forms. Morphology, far from indicating universal essences, indicated adaptations to the environment, which are not fixed by definition. Under this rubric, species were "units of evolution," and the goal of taxonomists became identifying ancestors common to different organisms.[31] No longer could one identify species with absolute categories; one must measure the distinctness of different species according to the extent of relatedness between them.[32]

In Darwin's own opinion, evolution effectively rendered taxonomy an arbitrary task.[33] He at least rejected any rigorous system of classification and appealed instead to common sense and experience: "In determining whether a form should be ranked as a species or a variety, the opinion of naturalists having sound judgment and wide experience seems the only guide to follow."[34] Darwin seemed unconcerned about the irrelevance of taxonomy when he wrote, "[i]t is really laughable to see what different ideas are prominent in various naturalists' minds, when they speak of 'species'.... It all comes, I believe, from trying to define the undefinable."[35] Whether or not undefinable, species constantly change, though at a very slow rate. Taxonomy, then, amounts to little more than an attempt to frame moving pictures.

3. Mayr's Biological Species Concept (BSC)

Despite the moving picture of evolution, morphological differences between organisms do exist, and in the wake of Darwin, scientists sought a unified theory of taxonomy.[36] In 1940, Ernst Mayr offered his biological species concept ("BSC") as a solution.[37]

30. MAYR, *supra* note 11, at 269.
31. Hill, *supra* note 14, at 249.
32. *Id.*
33. Doremus, *supra* note 18, at 1090.
34. MAYR, *supra* note 11, at 267.
35. *Id.* Darwin was not the only one to view "species" as dubious. Philosophers such as Leibniz and Locke contended that while nature may be organized into some cognizable order, to a great extent "species" is a human construct that lacks a one-to-one correspondence with the empirical world. *See id.* at 263-64. Similarly, according to this nominalist approach, Lamarck at one time believed that species do not exist, that only individuals do. *Id.* at 269. While Darwin was not a nominalist, he does represent a move away from a rigid definition of "species."
36. *See* Doremus, *supra* note 18, at 1090.
37. *See* O'Brien & Mayr, *supra* note 19, at 1187.

The defining characteristic of the BSC is neither morphology nor evolution, but sexual compatibility.

After clarification by Mayr, the definition states, "[a] species is a reproductive community of populations (reproductively isolated from others) that occupies a specific niche in nature."[38] Reproductive isolation refers to the tendency of distinct groups to avoid interbreeding even when they are in contact in nature.[39] A niche refers to an organism's particular ecological role in competing for natural resources.[40] Stated otherwise, then, species are groups of organisms that actually live in nature, compete for resources, and interbreed while not breeding with other groups.

Species maintain their reproductive isolation through various isolation mechanisms.[41] Mayr distinguishes between premating and postmating mechanisms.[42] Premating mechanisms prevent mating from occurring, while postmating mechanisms prevent the successful creation of offspring despite copulation.[43] Premating mechanisms usually involve some external barrier to copulation, such as seasonal or habitat differences between different groups that prevent them from even meeting.[44] Postmating mechanisms involve either mortality of the sexual gametes or zygotes or the reduced viability or sterility of offspring.[45] Mayr recognizes with others, however, that organisms that would otherwise differ from each other in taxonomy and genetics do sometimes interbreed and produce viable offspring.[46] This breakdown of isolation mechanisms produces organisms called hybrids.[47]

The BSC synthesizes past species concepts first by focusing on reproductive isolation since it is fundamental to the process of speciation, or the evolution of new species.[48] When an interbreeding group is isolated from other groups, it maintains an internal genetic cohesion by exchanging adaptive traits.[49] Secondly, morphology

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38. MAYR, *supra* note 11, at 273.
39. O'Brien & Mayr, *supra* note 19, at 1187.
40. *See* ACADEMIC PRESS DICTIONARY OF SCIENCE AND TECHNOLOGY (1996), *at* http://www.academicpress.com/inscight/07301997/niche1.htm (last visited November 6, 2002) (defining niche as "the unique position occupied by a particular species, conceived both in terms of the actual physical area that it inhabits and the function that it performs within the community").
41. MAYR, *supra* note 12, at 55.
42. *Id.* at 57.
43. *Id.* at 57-65.
44. *Id.* at 57-64.
45. *Id.* at 57, 64-5.
46. *See id.* at 69.
47. *Id.*
48. Doremus, *supra* note 18, at 1090.
49. *See id.* at 1091.

plays a role since, though not determinative of species, it serves as a rough marker for the genetic traits of a species.[50]

One must note some crucial idiosyncrasies of the BSC. Because it rejects the notion of abstract essences defining species and instead focuses on populations,[51] the BSC deals with real groups of organisms; it is thoroughly descriptive rather than prescriptive. Thus, it cannot tell one how to delimit species, though it does allow one to determine the categorical rank of taxa.[52] By focusing on populations, further, the BSC cannot answer whether a particular individual organism out of context belongs to a certain species. Additionally, species exist only in relation to other species.[53] As Mayr explains, to be a "species" is analogous to being a "brother."[54] The designation "species," he concludes, does not refer to an intrinsic property or essence of a group; rather, it indicates isolation from other groups.[55]

C. Other Categories

The ESA and administrative regulations use scientific terms in addition to "species" that are relevant in deciding whether an organism can receive ESA protection. One such term that garners even less consensus than "species" is "subspecies."[56] Mayr has defined "subspecies" as "an aggregate of phenotypically similar populations of a species inhabiting a geographic subdivision of the range of the species and differing taxonomically from other populations of the species."[57] Attempting to clarify this definition, Mayr later wrote that a subspecies must share a unique geographic range, phenotypic characters, and unique natural history.[58] Thus, subspecies represent some smaller set below species that shares a unique characteristics that warrant its own category. Yet scientists generally agree that a "subspecies" is not a unit of evolution[59] but is instead merely a unit of convenience.[60]

Unlike the scientifically dismissed term "subspecies," the term "population" is essential to taxonomy. A level of organization lying between the individual and species, a population is a group of

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50. *Id.*
51. MAYR, *supra* note 11, at 272.
52. *Id.* at 273.
53. MAYR, *supra* note 12, at 14.
54. *Id.*
55. MAYR, *supra* note 11, at 286.
56. *See* Doremus, *supra* note 18, at 1101.
57. MAYR, *supra* note 12, at 210.
58. O'Brien & Mayr, *supra* note 19, at 1188.
59. MAYR, *supra* note 12, at 210.
60. Doremus, *supra* note 18, at 1101.

individuals sharing a single gene pool such that any two individuals of opposite sex have an equal probability of mating with each other.[61] Individual organisms serve as simply "temporary vessels" that compose only a small portion of the gene pool.[62] Moreover, individuals do not change in response to environmental conditions while populations do.[63] Only at the level of populations do genes interact in combinations numerous enough so that gene pools can visibly manifest themselves.[64] Thus, scientists recognize populations as the basic units of evolution.[65]

Finally, another term that figures prominently in the debate over ESA species determinations is "hybrid." Even though the definition of "species" turns on reproductive isolation, the isolating mechanisms can fail, and two organisms that differ substantially may breed.[66] Scientists refer to the resulting organism as a hybrid rather than a member of either of its parents' species.[67] Hybridization is thus defined as "the crossing of individuals belonging to two unlike natural populations that have secondarily come into contact."[68] Like subspecies, hybridization serves as another convenient classification tool to explain how apparently distinct organisms can produce offspring.

The flexibility one finds in the scientific definitions of "species" and other terms is perhaps a practical necessity. The natural world is fluid and does not neatly fit into any one classification scheme. The flexibility is therefore necessary since, after all, scientific categories should conform to the natural world and not the other way around.

III. LEGAL DEFINITIONS OF "SPECIES"

Whether a group of organisms constitutes a separate species under the ESA does not simply depend on whether a biologist makes such a determination in a peer-reviewed journal. "Species" under the ESA is a uniquely legal term that constrains the listing process. Congress has repeatedly decided to leave the statutory definition of

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61. MAYR, *supra* note 12, at 82.

62. *Id.* at 83.

63. *See* Michael Goodman, *Preserving the Genetic Diversity of Salmonid Stocks: A Call for Federal Regulation of Hatchery Programs*, 20 ENVTL. L. 111, 119 (1990).

64. *See* MAYR, *supra* note 12, at 83.

65. Goodman, *supra* note 63, at 113.

66. *See* MAYR, *supra* note 12, at 69.

67. *See id.*

68. *Id.* "Hybridization," far from clarifying the definition of species, seems to conflict with it and begs the question of species definition. If the inability of two organisms to create viable offspring draws a bright line between two species but the ability to create fertile hybrids does not, how can reproductive isolation define a species?

"species" vague. Moreover, Congress defers to the listing agencies by allowing them to define "species" based on the best available scientific and commercial data.[69] The agencies, in turn, have created an often nuanced definition, though their listing decisions are not always based on purely scientific criteria.[70] The courts, finally, have not provided comprehensive commentary on the term "species," though they have made important decisions on certain points. The end result is that, despite emphasis on scientific data, the legal framework provides listing agencies with substantial deference in declaring a group of organisms a species.

A. *Statutory Analysis of the ESA*

After analyzing both the current language of the ESA and that of precursor legislation along with the accompanying legislative history, two themes emerge regarding the definition of "species." First, the progression from early legislation to the current ESA is marked by inclusion of additional terms in the definition and consequently an expansion of coverage. Second, as endangered species legislation developed, Congress placed more emphasis on scientific opinions. These two themes, though independently justifiable, conflict when placed in the same statutory scheme.

1. Background

Major endangered species legislation arose with the Endangered Species Preservation Act of 1966.[71] The act did not define "species," and the scope of its coverage extended to native fish and wildlife whose "existence is endangered."[72] This simple scheme makes no distinction between species and subspecies and thus covers only so-called pure species when the entire population is threatened with extinction. In making listing decisions, the Secretary of Interior must sometimes refer to scientific opinion.[73] With the Endangered Species Conservation Act of 1969,[74] Congress added protection for subspecies of fish or wildlife. Yet Congress retained the requirement that coverage extends to only those species or subspecies that are threatened with "worldwide extinction"[75] to the exclusion of coverage for smaller populations that may be in danger

69. *See* 16. U.S.C. § 1533(b)(1)(A) (2000).
70. *See* Doremus, *supra* note 18, at 1112.
71. Pub. L. No. 89-669, 80 Stat. 926 (1966).
72. *Id.* § 1(c).
73. *Id.*
74. Pub. L. No. 91-135, 83 Stat. 275 (1969).
75. *Id.* § 3(a).

of extinction in their areas. Additionally, Congress mandated that listing decisions be based on "the best scientific and commercial data available."[76] Thus, precursor legislation to the ESA already revealed the theme of splitting larger groups into smaller ones to be protected and the importance of science.

Congress continued the trends when it enacted the Endangered Species Act of 1973.[77] This act explicitly defined "species" as "any subspecies of fish or wildlife or plants and any other group of fish or wildlife of the same species or smaller taxa in common spatial arrangement that interbreed with mature."[78] Most notably, this definition expanded coverage beyond subspecies to the population level and perhaps further, depending on the meaning of "smaller taxa." Moreover, Congress lowered the bar on the requisite danger facing species that warrants listing by first allowing species to be listed even if they are only "threatened" with becoming endangered.[79] Congress also shrunk the geographic area throughout which species must be threatened or endangered from "worldwide" to "a significant portion of its range."[80] In the remarkably eco-centric House Report,[81] the legislators explained that the underlying goal of the ESA is to protect genetic heritage. Ruminating on mankind's role in nature, the Committee states that "we are our brothers' keepers."[82] Nonetheless, the Committee acknowledged that preserving genetic heritage has utilitarian justifications too, since genetic variations are "potential resources."[83]

The current understanding of "species" took form only after a few amendments. In 1978, Congress amended ESA's definition of species to its current form by discarding the "smaller taxa" language of the original act and replacing it with "any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature."[84] Though the 1979 amendments did not alter the definition of species, the Senate Report acknowledged that the DPS category could possibly lead to overlisting, but

76. *Id.*
77. 16 U.S.C. §§ 1531-1543 (Supp. 1973).
78. *Id.* § 1532(11).
79. *Id.* §§ 1533(a)(1), 1532(15).
80. *Id.* §§ 1532(4), (15).
81. H.R. REP. NO. 93-412 (1973).
82. *Id.* at 5.
83. *Id.*
84. Endangered Species Act Amendments of 1978, Pub. L. No. 95-632, § 3(16), 92 Stat. 3751 (1978). Attempting to explain the amendment, the Conference Report confusingly states that the new definition excludes "taxonomic categories below subspecies...." H.R. CONF. REP. NO. 95-1804, at 17 (1978). Of course, a distinct population segment is nothing if not a taxonomic category below subspecies. *See* Karl Gleaves et al., *The Meaning of "Species" Under the Endangered Species Act*, 13 PUB. LAND L. REV. 25, 30 n.26 (1992).

predicted that the implementing agencies would "use the ability to list populations sparingly."[85] Finally, in 1982, Congress added the requirement that listing turn "solely on the basis of the best scientific and commercial data available"[86] to the exclusion of economic considerations.[87] The statutory language currently in effect was completed after 1982.

2. Current Language

Today, despite the nuances added through the amendments, and a few idiosyncrasies, the language relevant to the definition of species is basically simple. "Species" is defined to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature."[88] Under section 1533, species are listed when they are either "endangered" or "threatened."[89] Section 1532 defines "endangered species" to mean "any species which is in danger of extinction throughout all or a significant portion of its range" other than certain insects.[90] Finally, a "threatened species" is "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."[91]

The first obvious idiosyncrasy of the definition of "species" is the disparate treatment of fish and wildlife, on the one hand, and plants on the other. While the ESA protects whole species and subspecies of both groups, only fish and wildlife get protection at the DPS level. Another quirk is the disparate treatment of vertebrate and invertebrate fish or wildlife. The ESA protects vertebrate fish or wildlife subspecies and DPSs, yet invertebrate fish or wildlife are protected at the subspecies level only.

Finally, the definitions of the terms "species," "endangered species," and "threatened species" coalesce only when read in a certain order. Reading the definitions of endangered and threatened species before that of species seems to authorize protection only when a species as a whole, "throughout all or a significant portion of its range," is endangered or threatened. Reading the definition of species first, however, limits the "all or significant portion of its range" language by effectively defining "it"

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85. S. REP. NO. 96-151, at 7 (1979).
86. Endangered Species Act Amendments of 1982, Pub. L. No. 97-304, 96 Stat. 1420 (1982).
87. H.R. REP. NO. 97-835, at 20 (1982).
88. 16 U.S.C. § 1532(16) (2000).
89. *Id.* § 1533(a)(1).
90. *Id.* § 1532(6).
91. *Id.* § 1532(20).

as not only the species as a whole but additionally subspecies and DPSs. Thus, protected species include species in danger of becoming extinct, or in danger of becoming endangered, throughout all or a significant portion of (1) the range of the species as a whole, (2) the range of a subspecies, or (3) the range of a DPS. This broad definition culminates the expansion of statutory coverage.

3. Strictly Science Mandate

Though the definitions section, section 1532, plays a crucial role in listing decisions, the process for listing a species under the ESA is outlined in section 1533. Not only does section 1533 enumerate the factors that the Secretary can consider in making the determination, but it also insists on the primary role of science. What Holly Doremus calls the "strictly science mandate"[92] is the section 1533 requirement that the Secretary make listing decisions "solely on the basis of the best scientific and commercial data available to him."[93] Though this mandate was probably inspired by a desire to insulate the listing process from political pressures and provide an objective and certain basis for decisionmaking,[94] the listing process is still characterized by uncertainty.[95]

The strictly science mandate might not be problematic but for the fact that the ESA definition of "species" is itself an unscientific one. Neither does the definition mention reproductive isolation, nor is "distinct population segment" used in scientific literature.[96] Indeed, scientists may argue that the ESA definition, in addition to

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92. Doremus, *supra* note 18, at 1051.

93. 16 U.S.C. § 1533(b)(1)(A) (2000).

94. Doremus, *supra* note 18, at 1038.

95. As a matter of statutory construction, applicability of the strictly science mandate to the definition of species is not obvious. Doremus divides the listing process into two elements: the "taxonomy problem" and the "viability problem." *Id.* at 1087-88. According to Doremus, the "taxonomy problem" requires agencies to decide whether a group of organisms is a species under the ESA; if so, the "viability problem" requires agencies to decide whether that species is endangered or threatened. *Id.* at 1088; *see also* Endangered and Threatened Species; Puget Sound Populations of Pacific Hake, Pacific Cod, and Walleye Pollock, 65 Fed. Reg. 70514, 70517 (November 24, 2000) (to be codified at 50 C.F.R. pts. 223 and 224) [hereinafter Hake, Cod, Pollock Determination]. One might assume that the strictly science mandate would apply to both the taxonomy and viability problems. Yet 16 U.S.C. § 1533(b)(1)(A) explicitly states that the science mandate applies to "determinations required by (a)(1) of this section," which is the section authorizing the Secretary to determine whether a species is endangered or threatened, and not the determination of whether a group of organisms is a "species." The 1982 amendments, however indicated a legislative intent that economics can play no role in "*any* phase of the listing process," Pub. L. No. 97-304, 21, 96 Stat. 1411, 1411-16 (1982) (emphasis added), which should be guided instead by scientific and commercial data. The amendments thus imply that science should guide the species identification phase of the listing process.

96. *See* Southwest Ctr. for Biological Diversity v. Babbit, 980 F. Supp. 1080, 1085 (D. Ariz. 1997).

not accounting for all biological factors in species identification, actually conflicts with the biological definition.[97] Some would rectify this discrepancy by amending the definitions section to comport with Mayr's BSC definition,[98] while others would prefer a definition based on comparison of genetic information.[99] Some would just as soon not have legislators deal with scientific questions at all.[100] Whatever the remedy, all seem to agree that a basic tension inheres in the ESA between the role of science, the statute's text itself, and the underlying policy goals.

B. Administrative Interpretation

Given the relatively simple but certainly vague statutory framework, the agencies responsible for implementing the ESA[101] have offered no further clarification regarding a comprehensive definition of "species." With a few minor adjustments, the Code of Federal Regulations' definitions of "species," "endangered species," and "threatened species" track the statutory language.[102] Two aspects of the definition of "species" that FWS and NMFS have attempted to explicate are the distinct population segment and hybridization. Despite deceptively technical definitions, the regulatory framework for species identification still remains flexible to the chagrin of those who criticize the ESA for not being rigorously scientific enough[103] and those who criticize the agencies of promulgating incoherent policies and drifting with political currents.[104] When it comes to transgenic organisms, however, the agencies have proposed a policy that would provide no such flexibility and most often preclude protection.

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97. *See* M. Lynne Corn, *The Listing of Species: Legal Definition and Biological Realities*, Congressional Research Service (December 15, 1992) *at* http://www.cnie.org/NLE/CRSreports/biodiversity/biodv-10.cfm (last visited Nov. 6, 2002).

98. *See* Hill, *supra* note 14, at 264.

99. *See* Kevin W. Grierson, Note, *The Concept of Species and the Endangered Species Act*, 11 VA. ENVTL. L.J. 463, 487 (1992).

100. *See* William W. Steele, Jr., *Major Issues in Reauthorization of the Endangered Species Act*, 24 ENVTL. L. 321, 326 (1994) (Steele, the Associate Director for Natural Resources of the White House Office of Environmental Policy in 1994, remarked, "[o]ne of my worst nightmares envisions a congressional floor debate regarding the definition of 'subspecies' or 'distinct population.' This is an inherently scientific issue with no real place in the legislative process, and it should be resolved by scientists.").

101. *See supra* note 6 and accompanying text.

102. 50 C.F.R. §§ 424.02(e), (k), (m) (2000).

103. *See* Hill, *supra* note 14, at 264.

104. *See* Doremus, *supra* note 18, at 1112.

1. Species Identification Generally

In the absence of more specific definitions or policy statements, the listing agencies are free to determine whether a group of organisms is a species in whatever manner they want, short of being arbitrary and capricious. In practice, agencies have favored an all-factors approach, relying on different lines of evidence as they suit the situation.

In the recent listing of the Alabama sturgeon,[105] FWS responded directly to the question of how it identifies species. In replying to a public comment entitled "Genetics is the best science for making taxonomic determinations and trumps morphological analyses,"[106] FWS stated that the "most scientifically credible approach to making taxonomic determinations is to consider all available data involving as many different classes of characters as possible... [including] morphological, karyological (chromosomal), biochemical (including DNA analysis and other molecular genetic techniques), physiological, behavioral, ecological, and biogeographic characters."[107] Moreover, the weight that FWS gives any of these sources of data depends on factors including the availability, quality, appropriateness, and utility of each to the particular organism.[108]

As the sturgeon listing demonstrates, however, genetics currently plays one of the more important roles in species identification. Though not determinative, genetics often serves as the language in which taxonomic debates take place. The taxonomic status of the sturgeon was debated within the scientific community. Some scientists concluded that the fish was a species separate from another similar fish by using techniques such as nuclear DNA and mitochondrial DNA d-loop analysis, while other scientists reached the opposite conclusion using mitochondrial cytochome b locus analysis.[109] Acknowledging some disagreement over the sturgeon's taxonomic status, FWS nonetheless considered it a separate species by seeming to weigh the preponderance of scientific opinions.[110] Thus, listing agencies may not delve into the substance of genetic data; these data merely form the language of scientific conversation. The agency's job is listening for a consensus opinion.

105. Endangered and Threatened Wildlife and Plants; Final Rule to List the Alabama Sturgeon as Endangered, 65 Fed. Reg. 26,438 (May 5, 2000) (to be codified at 50 C.F.R. pt. 17).

106. *Id.* at 26,452.

107. *Id.*

108. *Id.*

109. *See id.* at 26,438.

110. *See id.* at 26,439.

2. Distinct Population Segment (DPS)

The section 1532(16) definition of "species" allows agencies to consider populations of organisms as independent species even though the species as a whole does not face extinction. The legislative history, however, indicates an expectation that the agencies will use this DPS category only "sparingly."[111] In Senate Committee Report 96-151, the Committee responded to the General Accounting Office's concern that the DPS standard could lead to absurd results like the listing of squirrels in one city park where their population is declining despite an abundance of squirrels in other parks nearby.[112] The Committee justifies the DPS, irrespective of any clarification by the agencies, by announcing that despite potential problems on a small scale the DPS provides protection to United States populations of organisms that might be abundant elsewhere,[113] which is apparently politically, if not scientifically, justifiable. Nonetheless, the agencies seem not to have heeded the "sparingly" language and use the DPS often.

In 1996, the FWS and NMFS issued a joint policy statement explaining how they would implement the DPS in listing, delisting, and reclassifying.[114] Under this policy, a DPS consists of three elements: discreteness, significance, and status. To be discrete, a population must have some characteristic that differentiates it from other populations. Specifically, a population must either be "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors," which can be shown through genetic evidence, or it must be "delimited by international governmental boundaries."[115] To be significant, a population must be important to the taxon to which it belongs. The agencies can consider, but are not limited to, the following factors:

> (1) Persistence of the discrete population segment in an ecological setting unusual or unique for the taxon, (2) Evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon, (3) Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more

111. S. REP. NO. 96-151, at 7 (1979).
112. *See id.*
113. *Id.*
114. Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act, 61 Fed. Reg. 4,722 (Feb. 7, 1996) [hereinafter DPS Policy].
115. *Id.* at 4,725.

> abundant elsewhere as an introduced population outside its historic range, or (4) Evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.[116]

Finally, the agency must determine the status of the population, meaning the agency will decide whether it is endangered or threatened according to the factors in section 1533(a).[117]

Though the policy statement is filled with factors, its flexibility in implementation is obvious. Indeed, the fact that the policy is written in terms of factors implicitly indicates a case-by-case application. Regarding the significance element, the agencies explicitly state that flexibility is essential since "it is not possible to describe prospectively all the classes of information that might bear on the biological and ecological importance of a discrete population segment."[118] Moreover, the agencies will not require genetic evidence to support a finding of distinctness,[119] nor will they require absolute reproductive isolation of the population from other populations.[120] Thus, the agencies at most indicate their general mindset: populations can be "species" if they somehow represent a unique and reproductively separated subset of the whole species, extinction of which would effect important losses on the whole species in terms of geography or genetics.

In 1991, NMFS issued its own policy regarding the application of the DPS standard exclusively to Pacific salmon.[121] For these fish, a population is a DPS only if it represents an "evolutionary significant unit"(ESU).[122] The language of this policy suggests that populations must satisfy more rigorous tests than those of the general DPS policy statement to qualify for DPS status. Instead of "discrete," Pacific salmon populations are DPSs only if they are "substantially reproductively isolated;"[123] instead of being "significant," they must "represent an important component in the evolutionary legacy of the species."[124] Yet even this policy gives

116. *Id.*
117. *Id.*
118. *Id.*
119. *Id.* at 4,723.
120. *Id.* at 4,724.
121. Policy on Applying the Definition of Species Under the Endangered Species Act to Pacific Salmon, 56 Fed. Reg. 58,612 (Nov. 20, 1991).
122. *Id.* at 58,618.
123. *Id.*
124. *Id.* The agency explains that the reproductive isolation of populations must be substantial enough to allow "important differences" to develop that distinguish them from other populations. *Id.* The evolutionary legacy element seems to increase the requisite

NMFS significant leeway. As in the general DPS policy, NMFS adds qualifying language that largely takes the bite out of the rule. Reproductive isolation, after all, need not be absolute, and a lack of "direct genetic or any other type of information" will not prevent DPS/ESU status.[125] Not wanting to restrict its future listing decisions, the agency announces that for these fish it will require a little more than for other fish. Consequently, though, the agency's determination that a population is an ESU is discretionary and made on a case-by-case basis.

In practice, as with general species determinations, the agencies consider many factors in making DPS determinations. Recent NMFS status review decisions use language apparently typed into and automatically spit out of agency computers. In the section usually called "Consideration as a 'Species' Under the ESA," NMFS states that it considers several kinds of information in the attempt "to delineate DPSs," including habitat characteristics, geographic variability in phenotypic and life history traits, use of mark-recapture studies, and traits that are inherited in a predictable way.[126] Moreover, in the sections called "*DPS Determination*," NMFS sometimes states that genetic evidence may indicate significant reproductive isolation and thereby identify discrete and significant segments of the species.[127]

Though not explicitly stated, the agencies use basically the same analysis when (1) determining if a population is distinct from the species as a whole (i.e., whether a DPS exists) and (2) assuming one exists, determining if two populations compose the same DPS. This second type of analysis usually occurs when it is clear that a petitioned group of organisms is distinct from the species as a whole, but it is not clear if the group as petitioned really comprises multiple DPSs. For example, NMFS received a petition to list the various types of Rockfish each as DPSs.[128] The NMFS determined that because of habitat characteristics, population structure, and genetic evidence that populations within each type of Rockfish did

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significance for a population in that a population must contribute "substantially to the ecological/genetic diversity of the species as a whole" such that extinction would "represent a significant loss to the ecological/genetic diversity of the species...." *Id.* Presumably, with these heightened standards, fewer populations can qualify as DPSs and therefore NMFS can list fewer "species."

125. *Id.*

126. *See, e.g.*, Hake, Cod, Pollock Determination, *supra* note 95, at 70,516; *see also* Endangered and Threatened Species; Puget Sound Populations of Copper Rockfish, Quillback Rockfish, Brown Rockfish, and Pacific Herring, 66 Fed. Reg., 17,659, 17,662 (Apr. 3, 2001) (to be codified at 50 C.F.R. pts. 223 and 224) [hereinafter Rockfish, Herring Determination].

127. *See, e.g.*, Rockfish, Herring Determination, *supra* note 126, at 17,663.

128. *Id.* at 17,659.

not belong to one DPS, but rather composed their own DPS.[129] Additionally, with particular relevance to transgenic salmon, a recent notice of determination cited differences in growth rates and ultimate sizes as reasons for concluding that two Pacific hake populations did not belong to the same DPS.[130]

In sum, the DPS standard gives agencies a tool for protecting small groups of organisms relative to the species as a whole. To be protected, these groups must exhibit some unique inherent trait, occupy a unique ecological and geographical role, and represent a significant part of the species as a whole. The particular grounds that determine the agency's decision, however, are largely for the agency to choose.

3. Hybrid Policy

Currently, NMFS and FWS do not have a final hybrid policy, though a proposed rule awaits promulgation.[131] The prior agency position on hybrids emanated from a series of legal opinions of the Interior Department's Solicitor, which discouraged protection for hybrids.[132] One such opinion prevented the use of hybridization as a tool for rescuing the Dusky Seaside Sparrow from extinction.[133] In the late 1970s, the Dusky's numbers plummeted so severely, that by 1981 only 5 specimens remained, all of which were male.[134] FWS rejected a plan under which these males would have been bred with females from another subspecies of the Seaside Sparrow and then the female hybrids would have been bred with the male Duskys in a process called back-crossing.[135] Even though later generations would share 98.4% of the same genetic material, FWS refused to protect the hybrids and withdrew funding for the program.[136] Consequently, the Dusky became extinct.[137] The basis for this and other of the Solicitor's opinions was a desire to preserve genetic purity,[138] which was supposedly corrupted by hybridization. Today, the agencies continue to deny listed status to hybrids.[139]

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129. *Id.* at 17,663.
130. *See* Hake, Cod, Pollock Determination, *supra* note 95, at 70,517.
131. *See* Proposed Hybrid Policy, *supra* note 7.
132. *Id.* at 4,710.
133. *See* Hill, *supra* note 14, at 245.
134. *Id.* at 258.
135. *Id.* at 259.
136. *Id.*
137. *Id.*
138. *See* Doremus, *supra* note 18, at 1110.
139. *See* Endangered and Threatened Wildlife and Plants; Final Rule to Remove the Plant "Echinocereus lloydii" (Lloyd's Hedgehog Cactus) from the Federal List of Endangered and Threatened Plants, 64 Fed. Reg. 33,796 (June 24, 1999) (to be codified at 50 C.F.R. pt. 17) (withdrawing protection from hedgehog cactus, which was determined to be a hybrid and not

Under the proposed policy, certain hybrids will be covered. The policy employs the term "intercross" instead of hybridization to refer to "all crosses between individuals of different species."[140] Coverage under the policy extends to intercross progeny resulting from the intercross of a listed with a non-listed species if the progeny share traits of the listed parent's taxon and more closely resemble the listed parents than some intermediate form between the listed and non-listed parents.[141] This policy, then, would probably provide coverage for organisms like the sparrow intercross progeny and will thus prevent needless extinctions.

This new policy is extremely significant to the issue of transgenic organisms. Speaking directly on point, the agencies state that as a general rule the policy would not protect any organism resulting from the "intentional intercrossing of species under confinement and the artificial transfer of genetic material from one taxonomic species into another (i.e., transgenics)."[142] The progeny may be covered, however, if they are part of an approved recovery plan.[143] The significance of this policy is two-fold. First, it unambiguously states the regulatory position that transgenic organisms occupy the status of hybrids or intercross progeny. Second, it establishes a presumption against coverage of transgenic organisms as endangered species. Thus, if the agencies adopt the new policy, transgenic organisms will only rarely receive protection.

C. *Judicial Interpretation*

Cases directly addressing the definition of "species" -- legal, biological, or otherwise -- are few in number. These cases do not offer a comprehensive account, but they give guidance in a few particular areas.

At least one federal court recognizes that the ESA definition of species is not a strictly scientific definition. A District Court in Arizona stated that the ESA definition is more expansive.[144] Pointing to legislative history, the court reasoned that a broader definition is justified because it allows the government to protect populations in the United States from going extinct, even if the worldwide population is healthy.[145] Similarly, the same court in a subsequent decision in the same case stated that a DPS is not

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a distinct species as initially thought).

140. Proposed Hybrid Policy, *supra* note 7, at 4,710-11.

141. *Id.*

142. *Id.* at 4,712.

143. *Id.*

144. Southwest Ctr. for Biological Diversity v. Babbit, 926 F. Supp. 920, 924 (D. Ariz. 1996).

145. *Id.*

simply broader than any scientific category but rather "appears nowhere in taxonomic science or literature" and "appears to be some sort of hybrid language that Congress carved out which is not based upon taxonomy."[146] Thus, despite the mandate that listing decisions be based on the best available scientific or commercial data, the courts acknowledge that the ESA permits listings based on its own somewhat non-scientific definition.

Another District Court stressed the importance of interbreeding in the ESA definition of "species." In the *Fund for Animals*[147] case, the plaintiffs sued the Florida Game and Fresh Water Fish Commission to enjoin it from allowing a four-day deer hunt designed to eliminate an apparent overcrowding problem.[148] The plaintiffs wanted to protect the Florida white-tail deer, a non-listed animal that resembles the Key Deer, a listed species.[149] To protect the white-tail, the plaintiffs argued that the two types of deer were the same species. Based upon expert testimony that the two deer types do not actually interbreed, the court held that the two are automatically different species, and therefore the white-tail should not receive the protection of the Key Deer.[150] Even though the two could interbreed, the "definition of 'species' in the Endangered Species Act contemplates *the act of interbreeding* to occur, in fact, during maturity, not the *possibility* that white-tail deer might someday biblically *know* the Key Deer."[151] Thus, this court makes a bright-line rule, however obvious, that requires a species under the ESA to at least be a group of interbreeding individuals.

Courts usually defer to the agencies when their decisions rest upon scientific evaluations. The Eleventh Circuit in *United States v. Guthrie*[152] upheld the agency decision that a group of organisms constituted a species despite some uncertainty within the scientific community.[153] The defendant in *Guthrie*, charged with the criminal possession and selling of Alabama red-bellied turtles, argued that these listed turtles should not have been considered as a separate species under the ESA.[154] The court cited the different scientific publications that the agency relied upon to make its determination

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146. Southwest Ctr. for Biological Diversity v. Babbit, 980 F. Supp. 1080, 1085 (D. Ariz. 1997).
147. Fund for Animals, Inc. v. Florida Game & Fresh Water Fish Comm'n, 550 F. Supp. 1206 (S.D. Fla. 1982).
148. *Id.* at 1207.
149. *Id.* at 1208.
150. *Id.* at 1209.
151. *Id.*
152. 50 F.3d 936 (11th Cir. 1995).
153. *Id.* at 946.
154. *Id.* at 939.

and held that the agency did not abuse its discretion by considering the turtle a separate species despite the scientific uncertainty.[155] Though the case primarily demonstrates the deference courts will give to agencies when their decisions rest upon scientific information, it at least demonstrates that absolute scientific consensus is not a requisite for species determinations under the ESA.

Courts have, however, restrained the listing agencies when their policy statements or listing decisions contravene the text of the ESA definition. In the second *Southwest* case,[156] the court struck down a FWS policy that required petitions to list a DPS to include only one subspecies per DPS.[157] Thus, if an applicant seeks to list a DPS that consists of multiple subspecies, the applicant must make separate DPS petitions for each subspecies. Reading the statute strictly, the court noted that the "ESA *does not* refer to the listing of DPSs of *subspecies* ... if Congress had intended that a DPS contain only one subspecies, it would have allowed only the listing of 'DPSs' of *subspecies*."[158]

More recently, an Oregon district court prevented NMFS from making a listing decision at a level below the DPS/ESU.[159] In 1998, NMFS listed the Oregon Coast Coho Salmon as a threatened species, but in making the determination the agency included only "naturally spawned" salmon.[160] According to a policy statement that this case effectively strikes down, fish that are "hatchery spawned," or raised in an artificial propagation environment, will not be counted along with "naturally spawned" fish unless they are essential to the recovery of the species, even if the agency considers both the hatchery and naturally spawned fish to constitute one DPS/ESU.[161] The decision not to count the hatchery-spawned fish was arbitrary and capricious because NMFS had concluded that the hatchery and naturally spawned populations of salmon belonged to

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155. *Id.* at 945-46.

156. Southwest Ctr. for Biological Diversity v. Babbit, 980 F. Supp. 1080 (D. Ariz. 1997).

157. *See id.* at 1085.

158. *Id.* The decision is curious because, as the FWS argued, how can a DPS consist of more than one subspecies if subspecies are subsets of species and DPSs are even smaller subsets? If a group consists of multiple subspecies, each of which necessarily exhibits unique characteristics, then surely under the FWS policy statement on DPS listing, the group as a whole would not be discrete. Yet because DPS is not a scientific term, the court dismisses it and basically deprives it of any meaning at all. *See id.*

159. *See* Alsea Valley Alliance v. Evans, 161 F. Supp 2d 1154 (D. Or. 2001).

160. *Id.* at 1159.

161. *See id.* at 1158.

the same DPS/ESU[162] and that the ESA does not allow agencies to make distinctions within a DPS/ESU.[163]

The significance of *Alsea* should not be overstated. The case does not deal with the questions of whether a DPS exists or, assuming a DPS exists, whether it really comprises multiple populations. Instead, the case concerns the narrow question of whether, assuming a DPS exists and assuming that the two populations in question belong to the same DPS, the agency can nonetheless choose not to count the hatchery-spawned fish in determining whether the DPS is endangered or threatened. The court does not hold that hatchery-spawned fish cannot constitute a DPS of their own. In fact the court states quite the opposite: "[t]he NMFS listing decision could arguably be proper under the ESA if the NMFS defined 'hatchery spawned' coho as a separate DPS."[164] To do this would require the population to satisfy the DPS/ESU standard.[165] Neither does the court hold that hatchery spawned fish must always be counted along with naturally spawned fish in determining whether a DPS/ESU is endangered or threatened. Rather, the court takes as given the agency's decision that the two types of fish constitute one DPS/ESU. At least then the case stands for the proposition that fish from artificial propagation environments *can* be included in the same DPS with naturally spawned fish of an otherwise identical species. Once the DPS is delineated, however, the agency cannot make distinctions between members within the DPS because the ESA's text does not mention any such distinctions.[166]

As the judicial, administrative, and statutory authorities reveal, the legal definition of "species" is no clearer than the scientific definitions. The statutory framework essentially punts to the agencies, which have substantial deference to construe and apply the term. The agencies have exercised their discretion, for example, by deciding that hybrids are not species. More importantly for this comment is their indication that transgenic organisms are hybrids. The courts, finally, will restrain agencies' species determinations only when they clearly violate the ESA's language.

162. *Id.* at 1161.
163. *Id.* at 1162.
164. *Id.*
165. *Id.* The court notes, however, that in the case in question, the two populations interbred and so could not be discrete from each other.
166. *See id.*

IV. TRANSGENIC SALMON

Determining how certain organisms fit into the ESA scheme of species identification is an empirical endeavor that cannot be answered in the abstract. The place of transgenic salmon in the ESA depends on how they are made, where they live, and how they interact with other salmon. Understanding the place of transgenic salmon in the ESA enables one to predict what a policy statement on transgenic organisms under the ESA might look like and consequently to predict whether they could be listed or whether they are distinguishable from populations of basically similar fish minus the genetic modifications.

A. *Biology Behind Transgenic Salmon*

Transgenic salmon have their genesis in the biotechnological[167] techniques of genetic engineering. Genetic engineering allows scientists to incorporate desirable traits of one organism into another.[168] Traditional breeding has long exploited the fact that, though breeders could not have fully understood the mechanics until the twentieth century, DNA, which determines an organism's characteristics, will function even if it is transferred from one organism to another.[169] Breeders accomplish this genetic transfer by simply mating animals with different observable traits.[170]

Modern genetic engineering is infinitely more precise than traditional breeding. First, scientists can isolate individual genes along lines of DNA that represent given traits.[171] This isolated gene is then inserted into a fertilized egg through a variety of mechanisms. The insertion may involve Agrobacterium, electroporation, or particle gun transfer.[172] Often scientists attach the gene to some kind of molecular vehicle and directly inject the entire construct into the fertilized egg through a glass needle.[173] Eggs that survive and begin to divide are placed into a surrogate mother.[174] The resulting offspring are genetically modified organisms.[175] Genetic engineering has the added advantage over

167. *See* Betsch, *supra* note 1, at 1.
168. *Id.*
169. *Id.*
170. Carol Lewis, *A New Kind of Fish Story: The Coming of Biotech Animals*, FDA CONSUMER, Jan.-Feb. 2001, at 1, *available at* http://www.fda.gov/fdac/features/2001/101_fish.html (last visited Nov. 6, 2002).
171. *Id.*
172. Betsch, *supra* note 1, at 1.
173. Lewis, *supra* note 170.
174. *Id.*
175. *See* Kapuscinski, *supra* note 2, at 57.

breeding of not being limited by post-mating isolation mechanisms,[176] meaning scientists can combine desirable traits from organisms that are otherwise incapable of breeding.

Salmon have long been the subject of genetic engineering experiments. Since around 1980, scientists have attempted to create faster-growing salmon. Dr. Choy Hew, a Canadian researcher, discovered that certain flounder could survive in a tank that was accidentally frozen and then thawed.[177] Hew determined that the flounder has a gene, a so-called antifreeze gene, that allows it to survive in polar regions. Hew isolated the gene that acts like an on-off switch for the antifreeze gene, and he also isolated a gene from Chinook salmon that produces a growth stimulating hormone. He inserted these two genes into a fertilized salmon egg. Because the on-off switch gene seems to stay turned on, it continuously activates the growth hormone gene. The resulting fish therefore grow larger more quickly.

The only producer of transgenic salmon that is close to commercialization is Aqua Bounty Farms, a subsidiary of A/F Protein.[178] Using techniques similar to those of Dr. Hew, Aqua Bounty scientists incorporate the Chinook growth hormone and the promoter sequence (on-off switch) from the ocean pout fish into fertilized eggs from Atlantic salmon.[179] Their transgenic salmon grow anywhere from 2.5 to 6 times faster than normal salmon.[180]

B. Regulation of Transgenic Salmon

Companies like Aqua Bounty hope to capitalize on their salmon's potential for increased production by selling the fish to net pen salmon farms that will raise them as future food sources.[181] Though no transgenic fish have been approved as food sources[182] Aqua

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176. *See supra* notes 41-47 and accompanying text.

177. Lewis, *supra* note 170, at 1.

178. *See* Kapuscinski, *supra* note 2, at 57; Aqua Bounty Farms, *supra* note 2.

179. *See* Kapuscinski, *supra* note 2, at 57. A DPS of Atlantic salmon was listed in 2000 as an endangered species. *See* Endangered and Threatened Species; Final Endangered Status for a Distinct Population Segment of Anadromous Atlantic Salmon (*Salmo salar*) in the Gulf of Maine, 65 Fed. Reg. 69,459, 69,479 (Nov. 17, 2000) (to be codified at 50 C.F.R. pts. 17 and 224) [hereinafter Anadromous Atlantic Salmon].

180. *See* Kapuscinski, *supra* note 2, at 57. Aqua Bounty has named its particular type of salmon "AquAdvantage Bred salmon." Aqua Bounty Farms, *supra* note 2.

181. *See* Kapuscinski, *supra* note 2, at 57. Dr. Choy L. Hew argues that only aquaculture can meet the increased demand for seafood products due to population growth. *See* Choy L. Hew & Garth Fletcher, *Transgenic Fish for Aquaculture*, CHEMISTRY & INDUSTRY, Apr. 21, 1997.

182. John Matheson, *Questions and Answers About Transgenic Fish*, United States Food & Drug Admin., Center for Veterinary Medicine, *at* http://www.fda.gov/cvm/index/consumer/transgen.htm (last visited Nov. 6, 2002).

Bounty itself claims already to have orders for 15 million genetically engineered eggs.[183]

Aqua Bounty has submitted an application to the Food and Drug Administration for commercial approval of their salmon,[184] even though the FDA website has not posted the application or even mentioned that an application has been received.[185] The FDA does indicate, though, that it would regulate the fish as drugs rather than food[186] because the growth hormone used in their production is already considered a drug.[187]

C. Aquaculture Generally

The problem with commercially harvesting fish, transgenic or otherwise, is finding a place to put them all. Just as cattle farmers may use wide expanses of fenced in farmland to provide containment in a somewhat natural environment, so commercial fish harvesters may grow fish in natural bodies of water sectioned off by netting or floating cages.[188] The hatchery owners may raise the fish exclusively in the pens, or they may release the fish into the wild to increase the size of natural populations.[189] This manner of raising fish has many names including aquaculture, artificial propagation, and controlled propagation.

1. Potential Dangers

Michael Goodman argues that poorly designed hatchery programs pose serious threats to the adaptive gene pools, and thus the existence, of natural fish populations.[190] Hatcheries pose direct threats to gene pools through a destruction of genetic diversity even without reducing population size.[191] For example, nature has its

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183. *See* Rick Moore, *The Spawning of a New Era: GM Super Salmon and the Wisdom of Tinkering with Fish, at* http://www1.umn.edu/urelate/kiosk/12.00text/salmon.html (last visited Nov. 6, 2002); Union of Concerned Scientists, *Genetically Engineered Salmon, at* http://www.ucsusa.org/food_and_environment/biotechnology/page.cfm?pageID=327 (last revised Oct. 29, 2002) [hereinafter UCS Update].

184. Kapuscinski, *supra* note 2, at 57; E-mail from Elliot Entis, President of A/F Protein, Inc. (September 17, 2001).

185. UCS Update, *supra* note 183.

186. *See* Matheson, *supra* note 182.

187. *See* UCS Update, *supra* note 183. Though the agency does not explain why it will regulate the fish this way, the Union of Concerned Scientists postulates that the drug framework has an advantage over the food framework in that drugs, unlike foods, must pass pre-market review of health and environmental risks. However, the drug regulations do not allow much public participation. *Id.*

188. *See* Moore, *supra* note 183.

189. *See* Goodman, *supra* note 63, at 123-24.

190. *See id.* at 125-26.

191. *Id.*

own process, natural selection, for choosing which traits or alleles will work in the wild.[192] Hatchery managers, however, often engage in so-called artificial selection by tossing out fish with commercially undesirable traits, like slow growth rates, and keep fish that grow quickly and large.[193] The result is an artificial population sharing a homogeneous gene pool of traits that are not always beneficial in the wild (i.e. contribute to low fitness).[194] The hatchery manager's artificial selection process keeps the population size steady, even though in nature fish with these traits would die off.[195] If generation after generation of these naturally unfit fish are released into the wild, the artificially selected traits find their way into natural gene pools through the process of introgression and threaten the continued existence of wild populations.[196]

Artificially propagated fish also indirectly threaten natural gene pools by reducing the size of natural populations. Hatchery fish can be released in such numerous amounts that they crowd out and compete with natural fish for resources.[197] Additionally, hatcheries are often breeding grounds for diseases, which are then transmitted to natural populations upon release or by seeping through the underwater netting.[198]

As the agencies have recognized, aquaculture is a significant source of species endangerment.[199] Additionally, the Environmental Defense Fund concluded that "[a]quaculture facilities constructed or operated without environmental protection in mind can cause serious environmental degradation...."[200] Whether or not one disputes the full effect of aquaculture on the environment, even those in favor of aquaculture agree that new technologies can obviate some of the possible problems.[201]

2. Aquaculture of Endangered Species

Not only commercial fish harvesters benefit from aquaculture. Listing agencies and conservation groups may view aquaculture as

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192. *See id.* at 126.
193. *Id.* at 128.
194. *Id.* at 129.
195. *Id.*
196. *Id.*
197. *See id.* at 135.
198. *See id.* at 137.
199. *See* Anadromous Atlantic Salmon, *supra* note 179, at 69,478 (considering escapes from aquaculture to be a manmade factor affecting the continued existence of the salmon).
200. REBECCA GOLDBURG & TRACY TRIPLETT, ENVT'L DEFENSE FUND, MURKY WATERS: ENVIRONMENTAL EFFECTS OF AQUACULTURE IN THE US 16 (1997).
201. Hew & Fletcher, *supra* note 181.. Hew and Fletcher offer indoor, self-contained facilities as alternatives to floating cage aquaculture. *Id.*

a mechanism for preserving fish species. Listing agencies have promulgated two relevant policies. Both are arguably guided by the ESA definition of "conservation," which includes "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary... [and may include] propagation...."[202]

The NMFS and FWS have a joint policy providing that artificial or controlled propagation can be used to prevent the extinction of listed species provided they consider the risks, including risks of genetic introgression and adverse impacts to wild populations of listed species, determine that other measures have failed, and base the programs on specific recommendations in an approved recovery plan.[203] The NMFS also promulgated policy exclusively applicable to Pacific salmon.[204] Under this policy, specimens of listed Pacific salmon DPSs can be bred in hatcheries, but they will not be counted in with naturally spawned fish in the same DPS unless they are "essential for recovery."[205] Two circumstances where this might apply are where there is a "high, short-term risk of extinction, or if the hatchery population is believed to contain a substantial proportion of the genetic diversity remaining in the species."[206] The Pacific salmon policy, then, requires a more serious threat of injury to the natural populations in the absence of artificial propagation in order to permit artificial propagation.

As is the proposed hybrid policy,[207] the joint policy on artificial propagation is particularly significant for transgenic salmon. Like the proposed hybrid policy, this policy defines "intercross" to mean the "genetic exchange between individuals of different species [or] subspecies...."[208] This policy explicitly states that "[i]ntercrossing will not be considered for use in controlled propagation programs unless recommended in an approved recovery plan; supported in an approved genetic management plan ... implemented in a scientifically controlled and approved manner; and undertaken to compensate for a loss of genetic viability...."[209] Thus, generally the

202. 16 U.S.C. § 1532(3) (2002).

203. *See* Policy Regarding Controlled Propagation of Species Listed Under the Endangered Species Act, 65 Fed. Reg. 56,916, 56,920 (Sept. 20, 2000) [hereinafter Controlled Propagation Policy].

204. Interim Policy on Artificial Propagation of Pacific Salmon Under the Endangered Species Act, 58 Fed. Reg. 17,573 (Apr. 5, 1993) [hereinafter Pacific Salmon Artificial Propagation Policy].

205. *Id.* at 17,575.

206. *Id.*

207. Proposed Hybrid Policy, *supra* note 7 at 4,710.

208. Controlled Propagation Policy, *supra* note 200, at 56,919.

209. *Id.* at 56,920.

policy does not regulate artificial propagation of transgenic fish. Rather, it limits the artificial propagation of transgenic fish that are at least partially composed of listed species.

D. Aquaculture of Transgenic Salmon: The "Trojan Gene Effect"

As if the risks of aquaculture in general were not serious enough, using transgenic fish raises additional issues.[210] To prevent injury to natural populations if hatchery spawned transgenic fish escaped into the wild, companies like Aqua Bounty argue that they can simply produce sterile salmon and so prevent them from reproducing in the wild.[211] The problem with this biological barrier to reproduction is, first, sterilization procedures are not always effective and, second, for large outputs of fish, screening of each individual fish is cumbersome.[212] Thus, some accidentally fertile transgenic fish could still escape into the wild.

A provocative recent study by William Muir and Richard Howard from Purdue University projected serious dangers to natural fish populations if transgenic fish do escape.[213] To state their conclusion bluntly, they predict that "a transgene introduced into a natural population by a small number of transgenic fish will spread as a result of enhanced mating advantage, but the reduced viability of offspring will cause evaluated extinction of both populations."[214] Muir and Howard conducted experiments using transgenic fish that have the same characteristics as those made by Aqua Bounty. The researchers' fish were Japanese medaka inserted with a human growth hormone gene and salmon promoter gene. Their tests revealed that survival of transgenic young was 70% of that of wild young, or a 30% disadvantage. They also conducted mating experiments and found that in general, transgenic or not, larger males have a mating advantage of 400% over smaller ones. Though the medaka had an increased juvenile growth rate, their ultimate adult body size was not larger than wild medaka; Muir and

210. Atlantic Salmon Federation, *Aquaculture: Its Challenges for the Wild Atlantic Salmon*, Brief to the Senate Committee on Fisheries, *at* http://www.asf.ca/Aquaculture/senate.pdf (Feb. 29, 2000) (arguing that transgenic salmon only add to the existing threats of aquaculture). For general coverage of the issue, see a summary of CBS Evening News, *Genetic Tinkering for Bigger Catch* (Feb. 14, 2000) *at* http://www.cbsnews.com /stories/2000/02/14/eveningnews/main160S40.shtml (on file with the Journal of Land Use & Environmental Law).

211. *See* Hew & Fletcher, *supra* note 181; Moore, *supra* note 183.

212. *See* Kapuscinski, *supra* note 2, at 61.

213. *See* Muir & Howard, supra note 3, at 13856. *But see* Hew & Fletcher, *supra* note 181. Hew and Fletcher claim that "[i]n terms of ecology, there is no evidence that transgenics disrupt the ecological balance...". *Id.*

214. Muir & Howard, *supra* note 3, at 13,853.

Howard therefore concluded that the transgenic male medaka probably would not have an increased mating advantage. They nonetheless modeled the possible effects of a transgene release assuming that the growth rate would continue throughout adulthood because other fish species, including salmon, continue to grow through adulthood when altered with growth hormone genes.

Muir and Howard applied these data to a simulation model with staggering results. They assumed that sixty transgenic fish were introduced into a wild population of 60,000. If the 400% mating advantage is not factored in, but the 30% viability disadvantage is, the wild populations should recover without a problem and the transgene should be eliminated in twenty generations.[215] Yet, when Muir and Howard combined the effects of the mating advantage and reduced viability, the transgene spread quickly throughout the wild populations and the population was completely eliminated in forty generations.[216] The researchers referred to the extinction phenomenon as the "Trojan gene effect" because, in summary, "the mating advantage provides a mechanism for the transgene to enter and spread in a population, and the viability reduction eventually results in population extinction."[217]

Results such as the "Trojan gene effect" should factor prominently in the debate over the scope the ESA's definition of "species." Given such troubling possibilities, policy makers should consider the incentives to distinguish the transgenic from natural fish and thereby protect the natural ones, as well as the disincentive to waste resources to protect fish that are bred to die.[218]

E. Consideration of Transgenic Salmon as a "Species"

Whether transgenic salmon are a "species" under the ESA is too broad an inquiry. Species identification requires groups of actual organisms living in actual environments. An academic inquiry, then, requires certain assumptions about the groups under scrutiny. For transgenic salmon, the hypothetical circumstances with the most pressing relevance involve facts similar to those in the *Alsea* case, in which the court prohibited agencies from distinguishing

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215. *See id.* at 13,854-55.

216. *See id.* at 13,855.

217. *Id.*

218. Some fish farmers are quick to point out that they do not use transgenic fish. In responding to the CBS news broadcast, Atlantic Salmon of Maine announced on its website that it "would not endorse or even experiment with a 'GMO' (genetically modified organism) salmon unless exhaustive study were done, in advance, to satisfy us that there were no harmful affects to consumers or the environment." Majestic Farms, Response to the CBS news broadcast on "GENETIC TINKERING FOR BIGGER CATCH," *at* http://www.majesticsalmon.com/gmopolic.html (last visited Nov. 6, 2002).

between naturally spawned and hatchery spawned fish within the same DPS.[219] Part IV. E asks slightly different questions. First, Part IV. E considers whether agencies can distinguish between hatchery spawned transgenic salmon and naturally spawned salmon for the purpose of determining whether the two populations compose the same DPS. In answering this first question, Part IV. E also considers whether, assuming the two populations do compose the same DPS, the agencies may nonetheless refuse to count the transgenic fish by virtue of their being transgenic. Second, Part IV. E considers whether hatchery spawned transgenic fish could constitute their own DPS.

The transgenic salmon in this inquiry are modeled after those modified by Aqua Bounty and are composed of Atlantic salmon with the Chinook salmon growth hormone gene and the ocean pout promoter gene. The Atlantic salmon used must be from a non-listed DPS,[220] but let the salmon be a DPS that is petitioned for listing. Further assume that the genes have the effect of increasing both the growth rate and ultimate size of the salmon. Finally, assume that the transgenic fish are raised in hatcheries for commercial purposes and that they somehow escape into the wild. This comment will consider the ramifications if (1) the escapees are considered hybrids, (2) regardless of hybrid status, the escapees interbreed with wild populations of the Atlantic salmon petitioned for listing, or (3) regardless of hybrid status, the escapees do not interbreed with wild populations but form their own isolated population segment.

1. Transgenic Salmon as Hybrids

The quick and easy answer is that under the proposed agency position on hybridization, transgenic salmon are intercross progeny, and the agencies would thus have to distinguish between the populations; the escapees would receive no protection. Under the proposed policy, the processes through which the escapees were created meet the broad definition of intercross that includes the "artificial transfer of genetic material"[221] between species given the combination of Chinook and pout fish genes with Atlantic salmon. Moreover, since the escapees were created for commercial production, they cannot satisfy the exclusion for organisms that are produced for purposes of recovery of a listed species under a recovery plan.[222] Were the proposed hybrid policy effectuated, the

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219. *See* Alsea Valley Alliance v. Evans, 161 F. Supp. 2d 1154 (D. Or. 2001).
220. *See supra* notes 188-201 and accompanying text.
221. Proposed Hybrid Policy, *supra* note 7, at 4,712.
222. *Id.*

escapees would not be protected regardless of whether or not they interbred with wild Atlantic salmon. As a *proposed* policy, however, the agency may change its position before rendering its final policy, however unlikely.

The proposed hybrid policy's exclusion of transgenic organisms makes good sense. First, it makes the regulatory position on hybrids more compliant with the statutory strictly science mandate.[223] By providing protection to some hybrids, the policy recognized what scientists had long contended; hybridization between subspecies is a common and natural process.[224] This realization also permits agencies to use hybridization as a technique for preserving species at a high level of genetic purity as was prohibited for the Dusky seaside sparrow.[225] Secondly, and most important, by generally excluding transgenic organisms from the newly created hybrid protection, the agencies ensure that only those hybrids that preserve natural genetic heritage receive protection. From the Act's inception, Congress expressed its concern for preserving the genetic heritage developed by nature over evolutionary time scales.[226] Thus, the exclusion better fulfils the policy that the ESA should not protect just any genetic heritage but only that heritage that develops though natural processes.

2. Distinguishing Transgenic from Non-Transgenic Salmon

Were one to set aside the issue of transgenic salmon as hybrids, traditional DPS analysis would make distinguishing between interbreeding populations of escapees and wild salmon difficult. The significance of being able to distinguish between the transgenic escapees and petitioned wild salmon is that, in distinguishing them, the listing agency will not count the transgenic salmon with the wild salmon and will thus reduce the total number for purposes of listing. This reduced number in the abstract makes listing more likely. Conversely, if the two populations must be counted together, as in *Alsea*,[227] the total number increases and makes listing less likely.

The first way the agencies could refuse to count the transgenic fish is by determining that they do not belong to the same DPS as the petitioned fish. Some will argue that the agency should distinguish between the populations, primarily because the transgenic fish meet the DPS discreteness test for determining that

223. *See supra* Part III. A. 3.
224. Proposed Hybrid Policy, *supra* note 7, at 4,711.
225. *See supra* notes 137-38 and accompanying text.
226. *See* H.R. REP NO. 93-412, at 5 (1973).
227. *See* Alsea Valley Alliance v. Evans, 161 F. Supp. 2d 1154 (D. Or. 2001).

two groups belong to different populations.[228] The transgenic fish are markedly distinct in terms of physiology (morphology) because of their growth rate and ultimate size, both of which have been used to distinguish populations.[229] Moreover, they are discrete because of their unique genetic makeup. Genetic evidence, though not always required, is almost always used in DPS determinations. In the *Alsea* case itself, the court did not distinguish between the fish populations in part because it would create the "unusual circumstance of two *genetically identical* Coho Salmon swimming side-by-side in the same stream, but only one receives ESA protection while the other does not."[230] By contrast, in this section's hypothetical, the genetic difference between the two populations is not disputed; *transgenic* salmon are necessarily genetically distinct.

On the other hand, some will argue that calling the populations distinct from each other makes no sense if, as assumed here, they interbreed. Indeed the joint policy definition of discreteness centers on reproductive isolation. The definition states that populations are distinct if they are "markedly separated," in the sense of being isolated reproductively, as a consequence of what Mayr called isolation mechanisms: "physical, physiological, ecological, or behavioral factors."[231] The policy also states that the genetic and morphological data is used to "provide *evidence* of this separation."[232] Thus genetic and morphological differences are not ends in themselves; they are merely tools for establishing reproductive isolation.

The result is a strange situation and a legal stalemate. As the DPS policy assumes, usually populations that are reproductively isolated eventually manifest genetic or morphological differences. Here, however, the transgenic and wild populations interbreed *and* show genetic and morphological differences. Thus the transgenic salmon meet the individual factors supporting discreteness, but they fail the basic test of being markedly separated.

As a matter of policy, the stalemate should be resolved in favor of distinguishing the two groups. In light of the "Trojan gene effect,"[233] it would be silly to mandate inclusion in wild populations of a group that is lethal to the whole group; it would be legally perverse to say that the listing process itself could result in a take. In reality, though, this reasonable policy may not prevail. Even the

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228. *See supra* notes 114-15 and accompanying text.
229. *See supra* note 130 and accompanying text.
230. Alsea Valley Alliance, 161 F. Supp. 2d at 1163. (Emphasis added.)
231. DPS Policy, *supra* note 114, at 4,725.
232. *Id.* (Emphasis added.)
233. *See supra* Part IV. D.

Alsea case runs the risk of being perverse because the policy it rejected was based on protecting wild populations from the dangers of hatchery breeding to which hatchery fish are exposed.[234] Thus, the hatchery and naturally spawned fish had to be counted together despite the potential genetic and ecological dangers. Additionally, though the listing agencies are required to consider the best available scientific and commercial data, they are not required to follow any particular study. With the added safeguard of arbitrary and capricious judicial review, the agency would likely prevail if it chose not to follow the Muir and Howard study[235] in light of other evidence reaching different conclusions.

A second way the agencies could refuse to count the transgenic fish is by arguing that, while their being hatchery spawned is insufficient, their being transgenic provides a sufficient basis for ignoring them even assuming they and the wild fish compose the same DPS. To make this argument, however, requires the agencies to make distinctions at levels below the DPS, to distinguish between members within the DPS. The court in *Alsea* rejected just such an attempt.[236] Again, sound policy and common sense support distinguishing the populations. However, if other courts adopt the strict *Alsea* approach by reading the categories of possible species under the ESA literally, they will not allow agencies to make the distinctions.

3. Transgenic Salmon as a Separate DPS

Disregarding the "transgenic salmon as hybrids" issue would not, however, allow protection for isolated populations of escapees under traditional DPS analysis. If the escapees do not interbreed with wild populations, but form their own isolated population group, and thus satisfy the discreteness prong of the DPS test, the only issue is the significance of the population to the species as a whole. This second element of the DPS test centers largely on the importance of a given population to the geographic dispersal of a species insofar as the factors include persistence in an unusual setting, a significant gap in the species' range if the population dies off, and whether the population is the last natural occurrence of the species.[237] These factors are case specific, but for the sake of argument, assume that the transgenic population does live in a

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234. *See* Pacific Salmon Artificial Propagation Policy, *supra* note 204, at 17,574.

235. Muir & Howard, *supra* note 3.

236. *See* Alsea Valley Alliance v. Evans, 161 F. Supp. 2d 1154, 1162 (D. Or 2001). ("The central problem with the NMFS listing decision ... is that it makes improper distinctions, below that of a DPS....").

237. *See* DPS Policy, *supra* note 114, at 4,725.

unique area that effectively extends the overall range of the Atlantic salmon. The significance test also allows agencies to consider marked differences in the population's genetic characteristics as supporting separate DPS identification.[238] Again, transgenic salmon are by nature genetically unique.

Again, however, while transgenic salmon seem to satisfy the letter of the test, they contravene its purpose. The significance test measures the significance of the population "to the taxon to which it belongs."[239] Consequently, a population's significance is not measured in terms of an inherent right to exist; significance here is relative to the importance of a part to a whole. It is nonsense to argue that it is significant to the species as a whole to protect a creature created in a lab that dies in a few generations when put into the wild. To protect these populations from extinction wastes valuable time and money; the effort would amount to keeping alive organisms that are engineered to die. Then again, the ESA makes no such priority list and requires agencies to consider each petitioned species as if in a vacuum. Thus, species that are not adaptive and are "engineered to die" by evolution through natural selection could receive just as much protection under the ESA. The difference between the naturally and artificially selected organisms, though, is temporal. Scientists can create these non-adaptive organisms as quickly as they want whereas nature takes a long time. Extending protection to the manmade non-adaptive organisms opens the door to the absurd result of protecting any small group of transgenic organisms getting into the wild which is in danger of extinction, as quickly as scientists can make and release them. As the DPS policy was probably fashioned to prevent the absurd results mentioned by the GAO of protecting small groups of squirrels in city parks,[240] so it should prevent this absurd result.

In summary, the transgenic salmon escapees should not, and likely would not, be considered a "species" under the ESA. First, the proposed hybrid policy explicitly denies coverage to transgenic organisms in most circumstances, regardless of the existence or lack of reproductive isolation. Second, even ignoring the proposed policy, traditional DPS analysis would preclude coverage when the escapees form reproductively isolated communities because they are not significant to the species as a whole. Oddly, though, traditional DPS analysis may not provide a basis for distinguishing transgenic and non-transgenic salmon if other courts adopt the strict *Alsea*-type stance toward DPS identification. Yet since the agencies have

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238. *Id.*
239. *Id.*
240. *See supra* note 112 and accompanying text.

already indicated their position on transgenic organisms as hybrids, and since the agencies are not prohibited from implementing their position before they issue their final policy, the perverse results under traditional DPS analysis will probably never arise.

V. CONCLUSION

As the hypothetical demonstrates, species determination under the ESA can involve many twists and turns. The legal framework is far from the conceptually simple pigeonhole system of the essentialists. The legal definitions have come a long way in incorporating scientific ideas, such as reproductive isolation. Undoubtedly, however, the legal and scientific definitions do not directly correspond with each other. While Congress has indicated a desire for ESA listings to be scientific, it also imbued the ESA with policy goals. Species determination thus involves a balancing of technical definitions with guiding principles.

Regarding transgenic organisms, however, the legal framework will probably be much less complicated. The proposed hybrid policy gives the simple answer that transgenic organisms are considered hybrids and presumptively not protected. As a general rule, the policy is prudent. For organisms as hypothesized in this comment, agencies should certainly deny protection. The transgenic salmon pose serious ecological threats to wild populations, and are not engineered for natural environments. Protecting them would be perverse and simply waste resources that could be better channeled toward saving other species.

Whether the hybrid policy is wise in all circumstances, though, is not so clear. One can postulate a transgenic organism that has incorporated only a very slight genetic variation, is well suited to living in natural environments, and actually does establish its own reproductively isolated niche. If these organisms adapt seamlessly without the ecological detriment that the hypothetical transgenic salmon pose, why should they not receive protection if their habitat is threatened? To resort to the policy of protecting natural genetic heritage under the ESA simply begs the question. What "natural" means is no clearer than what "species" means.

Given the advances in biotechnology, the definition of "species" will probably become more muddled. But if the hybrid policy is any indication, the agencies seem to be working towards keeping the law current with the science and consistent with the policy goals of the ESA.