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THE CONCEPT OF SPECIES WITH CONSTANT REFERENCE TO KILLER WHALES

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> "*Compare the several floras of Great Britain, of France or of the United States, drawn up by different botanists, and see what a surprising number of forms have been ranked by one botanist as good species, and by another as mere varieties. Mr. H. C. Watson. . .has marked for me 182 British plants, which are generally considered as varieties, but which have all been ranked by botanists as species; and in making this list he has omitted many trifling varieties, but which nevertheless have been ranked by some botanists as species, and he has entirely omitted several highly polymorphic genera. Under genera, including the most polymorphic forms, Mr. Babington gives 251 species, whereas Mr. Bentham gives only 112, a difference of 139 doubtful forms.*"[1]
>
> -Charles Darwin, On the Origin of Species.

Abstract: Watson recognized 182 species, Babington 251, and Bentham only 112. Over 150 years since Darwin's time, scientists continue to debate what constitutes a species. But while this uncertainty remains unchanged, the law has: the United States has committed to protect individual (endangered) species. What was once merely an academic dispute now carries legal weight under the Endangered Species Act (ESA): recognition of a species can trigger significant economic consequences and non-recognition can doom a species to extinction. This comment examines the scientific roots of taxonomic uncertainty, the legal landscape of the ESA, and the potential unforeseen consequences of the relationship between the two. To aid in this examination, this comment highlights the taxonomic uncertainty related to the killer whales of the Eastern North Pacific and the legal fight over their taxonomic status.

1. CHARLES DARWIN, ON THE ORIGIN OF SPECIES 48 (1859), *available at* http://darwin-online.org.uk/Variorum/1859/1859-48-dns.html.

I. INTRODUCTION

It may be surprising to some that today, even with modern genetic tools at our disposal, uncertainty exists about where one species begins and another ends. This "taxonomic uncertainty" is widely prevalent. There are numerous causes for this, including: (A) multiple definitions of what constitutes a "species"; (B) the gradual process of evolution, in which speciation is incomplete and "fuzziness" between putative species occurs; (C) simply a lack of biological information. Lastly, (D) there is reason to suspect that future information will cause more uncertainty than it resolves.

A. *Disagreement over the Definition of "Species" and "Subspecies"*

1. *The Diversity of Species Concepts*

A plethora of species conceptions exist. In 1997, Mayden identified twenty-two conceptualizations.[2] In 2004, Coyne and Orr identified twenty-five.[3] Wilkins later expanded his

2. R. L. Mayden, *A Hierarchy of Species Concepts: the Denouncement in the Saga of the Species Problem in* SPECIES: THE UNITS OF BIODIVERSITY 381 (M. F. Claridge, et al. ed., 1997) (hereintafter "Mayden *Hierachy*").

3. JERRY A. COYNE & H. ALLEN ORR, SPECIATION 25 (2004).

catalogue to twenty-six unique definitions in 2009.[4] The number of species concepts corresponds to both the dynamic nature of evolution and the differing values of scientists.[5] Two species concepts are described below.

Ernest Mayr largely pioneered the seminal species concept, the Biological Species Concept (BSC).[6] Mayr defined species as "groups of actually or potentially interbreeding natural populations[,] which are reproductively isolated from other such groups."[7] According to the BSC, the test for a *true* species is whether individuals possess the capability to interbreed and to produce fertile offspring.[8] Various mechanisms (ecological isolation, breeding at different times, incompatibility of sexual organs, behavioral differences, prevention of fertilization, sterility of hybrids, etc.) work to prevent the homogenizing effect of gene flow.[9] A species may have multiple isolating mechanisms "arranged like a series of hurdles," preventing fertile offspring.[10] Even "if one breaks down, another must be overcome."[11] Thus, any interbreeding (hybridization) was thought by Mayr to be extremely rare.[12] Proponents of the BSC assert that its major advantage is that it not only identifies species, but it also provides an explanation for *why* populations fall into different groups.[13] Furthermore, it allows one to easily test a species hypothesis, as a separate species does not exist if the two populations can naturally reproduce.[14] On the other hand, critics of the BSC believe that its almost singular focus on reproductive isolation misses important nuances.[15]

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4. JOHN S. WILKINS, DEFINING SPECIES: A SOURCEBOOK FROM ANTIQUITY TO TODAY 193 (2009).

5. Mayden *Hierarchy*, *supra* note 2, at 389.

6. COYNE & ORR, *supra* note 3, at 28; Mayden *Hierarchy*, *supra* note 2, at 390; WILKINS, *supra* note 4, at 137–40.

7. ERNST MAYR, ANIMAL SPECIES AND EVOLUTION 19 (1963).

8. This is the conception of species that may be most familiar with readers.

9. COYNE & ORR, *supra* note 3, at 28–29; MAYR, *supra* note 7, at 92.

10. MAYR, *supra* note 7, at 107.

11. *Id*. For example, if ecological disturbance breaks down one barrier down, such as the physical separation of two populations, these groups may still not interbreed because of some other isolating mechanism, like behavioral differences.

12. *Id*. at 114.

13. COYNE & ORR, *supra* note 3, at 38.

14. Paul-Michael Agapow et al., *The Impact of Species Concept on Biodiversity Studies*, 79 THE QUARTERLY REV. OF BIOLOGY 161, 162 (2004).

15. COYNE & ORR, *supra* note 3, at 39–48 (noting that hybridization and allopatric

Additionally, where populations do not overlap, the BSC proves difficult in application.[16]

Rivaling the BSC for importance are the phylogenetic species concepts (PSCs), a family of species concepts that are concerned with documenting the interrelations between species and the evolutionary history of species.[17] Whereas the BSC is concerned with the process of speciation, PSCs are principally concerned with reconstructing "the history of life."[18] PSCs generally share the same test—a cluster of organisms with shared traits distinct from other organisms that also share a pattern of ancestry and descent[19]—but there are multiple distinct versions of the concept, each with their own emphasis. The nature of the shared ancestry is the common divergence point between different phylogenetic species concepts.[20]

PSC adherents claim that it better articulates the diversity of life and clarifies the nature of biodiversity.[21] Further, it is applicable to a wider array of life on earth, including asexual organisms and allopatric populations.[22] Critics of the PSCs argue that adoption will lead to a proliferation of new species, some of which may be transitory (as differences may emerge when populations are isolated but vanish when such barriers break down).[23] This stands in stark contrast to the permanence of the BSC—when reproductive isolating mechanisms are formed, this is a "biologically meaningful event" where "taxa become evolutionarily independent."[24]

There are numerous additional species concepts but the

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populations offer some of the most intrinsic problems with the BSC).

16. COYNE & ORR, *supra* note 3, at 39–40; JOHN S. WILKINS, SPECIES: A HISTORY OF THE IDEA 189 (2009) (highlighting the difficulty of applying the BSC to allopatric populations, noting that systematists must make a "judgment call" given "one cannot use reproductive isolation as a test in many cases").

17. COYNE & ORR, *supra* note 3, at 459.

18. *Id*.

19. Mayden *Hierarchy*, *supra* note 2, at 405–08.

20. *Id*.

21. *See* Joel Cracraft, *Species and its Ontology: The Empirical Consequences of Alternative Species Concepts for Understanding Patterns and Processes of Differentiation*, *in* SPECIATION AND ITS CONSEQUENCES 325 (Daniel Otte & John A. Endler eds., 1989).

22. Agapow et al., *supra* note 14, at 163.

23. Cracraft, *supra* note 21, at 330; COYNE & ORR, *supra* note 3, at 469–70.

24. COYNE & ORR, *supra* note 3, at 469.

disagreement and diversity between the two dominant concepts illustrates the point, as Mayr half-jokingly wrote, "[i]t may not be exaggeration if I say that there are probably as many species concepts as there are thinking systematists and students of speciation."[25]

2. *Choice of Species Concept Impacts the Number of Species Recognized*

The choice of a species concept has a real effect on the number of species recognized.[26] Generally, a PSC theory will recognize more species than a BSC theory.[27] Because of this, proponents of the BSC may dismissively refer to their PSC-colleagues as "splitters" because they split a single species into multiple separate species.[28] By the same token, adherents to a PSC theory refer to BSC proponents as "lumpers," as they lump multiple species together into a single species.[29]

One survey found that the use of a phylogenetic concept resulted in the recognition of approximately forty-nine percent more species than the use of a non-phylogenetic conception.[30] Among well-studied entities, such as mammals and birds, the difference is even more drastic. Phylogenetic studies resulted in a species increase of eighty-seven percent among mammals and eighty-eight percent among birds.[31] Specifically, a study of the endemic birds of Mexico yielded 101 birds under the BSC and about 249 under a phylogenetic concept.[32] Another study of endemic birds of sub-Saharan Africa yielded 1572 "biological" species and 2098 phylogenetic species, a 33.5 percent increase.[33]

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25. ERNST MAYR, SYSTEMATICS AND THE ORIGIN OF SPECIES 115 (L.C. Dunn et al. eds., 1942).

26. *See* JODY HEY, GENES, CATEGORIES AND SPECIES: THE EVOLUTIONARY AND COGNITIVE CAUSES OF THE SPECIES PROBLEM 20 (2001). Hey refers to this phenomena as "concept conflict."

27. *See, e.g.,* Agapow et al., *supra* note 14, at 168–69.

28. *See id*. at 164.

29. *See id*.

30. *Id*.

31. *Id*. at 168.

32. *Id*.

33. Shaun Dillon and Jon Fjeldså, *The Implications of Different Species concepts for Describing Biodiversity Patterns and Assessing Conservation Needs for African Birds*, 28 ECOGRAPHY 682 (2005). (The study was a rough sketch as genetic data was not

Notably though, while the application of a PSC usually results in the recognition of more species, this is not always the case. Under a phylogenetic conception, Mollusks tend to differentiate into fifty percent *fewer* species than under non-phylogenetic concepts.[34] However this may have less to do with a concept change and more to do with early amateur BSC taxonomists who classified species "over-enthusiastic[ally]."[35]

The choice of a species concept also influences the recognition of subspecies. Mayr defined a "subspecies" as "an aggregate of local populations of a species, inhabiting a geographic subdivision of the range of the species, and differing taxonomically from other populations of the species."[36] Subspecies are not biologically *real*; rather, "subspecies" is a term of convenience to describe the variety and diversity within a single species."[37] Other species concepts, such as PSCs, do not employ the classification of subspecies at all; for them, "species" are the lowest recognized taxa.[38] Instead of subspecies, these more expansive species concepts generally recognize subspecies under the BSC as distinct species in their own right. (Charges that this is inappropriate, a so-called "taxonomic inflation," are addressed in section III.B.)

B. *The Inherent "Fuzziness" of Species Boundaries*

Evolution does not create clean dividing lines between species.[39] A Darwinian understanding of evolution holds that speciation, the formation of new species, is a gradual process—the accretion of gradual genetic and morphological differences driven by natural selection.[40] Modern evolutionary biologists have rejected the idea of evolution occurring through wholesale jumps or breaks between species, a theory referred to as

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available for many phylogenetic species.)

34. Agapow et al., *supra* note 14, at 168.

35. *Id*.

36. MAYR, *supra* note 7, at 348.

37. *Id*. at 349.

38. *Id*.

39. *See* HEY, *supra* note 26, at 21; MAYR, *supra* note 7 at 24.

40. *See* HEY, *supra* note 26, at 21; ERESHEFSKY, THE POVERTY OF THE LINNAEAN HIERARCHY 95 (2001).

"saltation."[41]

Regardless of the relative speed of evolution, various stages exist after a population diverges. During these stages, genetic and morphological differences will have "progressed only part of the way toward species status"[42] causing "fuzziness" to exist between the populations.[43] Ernest Mayr referred to this condition as the "incompleteness of speciation."[44] Species "fuzziness" results in at least four common outcomes that complicate species identification.

First, the populations of a species at the far-ends of a large geographic area may behave as separate species if brought into contact with one another despite being part of an unbroken and interbreeding chain.[45] Ring species, an oft debated proposed phenomenon,[46] provides a neat example. A ring species encircles some geographic barrier, theoretically originating from a single ancestral population.[47] As the population expands, each population can interbreed with its most immediate neighbor, forming an unbroken chain of interbreeding.[48] However, where the ring closes, the two populations at the extreme ends have been isolated so long as to develop strong reproductive isolation.[49]

Second, some "perfect," wholly separate species (under any species concept) lack noticeable or pronounced differences in

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41. *See* MAYR, *supra* note 7, at 435; WILKINS, *supra* note 4, at 137 (2009). Note, saltation is different from "punctuated equilibrium"—a theory most famously advocated by Eldredge and Gould, which posits that evolution happens in bursts and spurts. Even in this theory, though evolution occurs quite rapidly, it still is gradual in the sense that it is the accumulation of changes generation after generation. By contrast with Darwinian gradualism, the time span of each speciation event is measured in periods of a few years or generations. *See* ERESHEFKY, *supra* note 40, at 96–97.

42. MAYR, *supra* note 7, at 24.

43. HEY, *supra* note 26, at 21. *See also* ERESHEFSKY, *supra* note 40, at 95–96; MAYR, *supra* note 7, at 24–27.

44. MAYR, *supra* note 7, at 24.

45. *Id*.

46. COYNE & ORR, *supra* note 3, at 102–04 (Coyne and Orr highlight the rarity of ring species, including the possibility that there are no such thing. That said, ring species are still important theoretically because "they show in a novel way that reducing gene flow promotes speciation.").

47. *Id*.

48. *Id*.

49. *Id*.

morphology.[50] These species do not often raise a theoretical difficulty, as they are certainly distinct species; but, the "sameness" in their morphology, especially when they have overlapping territory or ranges, has historically resulted in the "lumping" of many distinct species into a single species.[51] Scientists refer to these morphologically similar species by two names: cryptic species and sibling species. Some, including Mayr, use the terms "sibling species" and "cryptic species" interchangeably, although sibling species are technically a subset of cryptic species.[52] The importance of this is that routine taxonomic analysis fails to identify cryptic species.[53] Instead, scientists have often only distinguished cryptic species incidentally while studying them for medical, agricultural, scientific, or other reasons.[54]

Third, in contrast to cryptic species, morphological differences can appear within a species despite a lack of corresponding genetic divergence.[55] Polymorphism, a species with multiple unique morphological forms is not uncommon in nature.[56] Examples abound: consider the vat of diversity of human appearances, from height to skin color. However, some morphological differences are so pronounced as to confuse taxonomists. The butterfly *Heliconia erato*, for example, has two forms: red and blue.[57] Originally taxonomists thought these butterflies were two separate species.[58]

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50. MAYR, *supra* note 7, at 24–25.

51. *Id*. at 24.

52. Nancy Knowlton, *Cryptic and Sibling Species Among the Decapod Crustacea*, 6 J. OF CRUSTACEAN BIOLOGY 356 (1986) ("The term 'sibling species' has traditionally been used for sets of species that are difficult to distinguish using traditional morphological characters. 'Cryptic' when used taxonomically (as opposed to ecologically) is another frequently used term for the same concept. The latter is etymologically preferable since 'sibling' implies a particularly close relationship, a feature, which Mayr asserted did not differentiate sibling from other congeneric species. More recent studies have shown, however, that species that are difficult to tell apart morphologically may or may not be as distantly related to each other, on the basis of biochemical characters, as are morphologically distinct congeners." (internal citations omitted)); ERNEST MAYR & PETER D. ASHLOCK, PRINCIPLES OF SYSTEMATIC ZOOLOGY 91–93 (1991).

53. MAYR & ASHLOCK, *supra* note 52, at 92.

54. *Id*.

55. MAYR, *supra* note 7, at 25–26; MAYR & ASHLOCK, *supra* note 52, at 70.

56. MAYR & ASHLOCK, *supra* note 52, at 70.

57. DAVID N. STAMOS, THE SPECIES PROBLEM: BIOLOGICAL SPECIES, ONTOLOGY, AND THE METAPHYSICS OF BIOLOGY 305 (2003).

58. *Id*.

Sexual dimorphism, where the separate sexes have different morphological forms (besides differences in sexual organs), also causes species uncertainty.[59] Mallard ducks are a famous example.[60] The male duck has a shimmery bottle-green head, white collar, brown wings, and light grey body. The female lacks the bold colors of the male and sports a speckled brown coloring. As David Stamos puts it, "[U]nless one saw the males and females in pairs one would swear they were different species."[61] The sexual dimorphism of the mallard ducks even fooled Carl Linnaeus, the godfather of taxonomy. He incorrectly classified the male and female mallard ducks as separate species.[62]

Finally, within a single species, different populations occupying unique ecological niches may act like separate species as long as their habitat remains undisturbed.[63] Yet, once these habitats are altered—usually the result of human activities—the populations quit acting like unique species and interbreed freely.[64] "Grolar bears" or "pizzly bears," for example, a fertile hybrid between polar bears and grizzly bears (a subspecies of brown bears known for their "grizzled" fur) are causing species confusion.[65] Polar bears have long been considered a true species apart from grizzly bears.[66] But ranges of these two species now overlap; longer summers and melting ice are pushing polar bears farther south and inland, while human activities are pushing grizzlies farther north.[67] As a result, some expect that hybridization will become

59. *Id*. at 68.

60. *See* STAMOS, *supra* note 57, at 305; MAYR & ASHLOCK, *supra* note 52, at 55.

61. STAMOS, *supra* note 57, at 305.

62. STAMOS, *supra* note 57, at 305; MAYR & ASHLOCK, *supra* note 52, at 55.

63. MAYR, *supra* note 7, at 26.

64. *Id*.

65. Josh Wingrove, *Hybrid Grizzly-Polar Bears a Worrisome Sign of the North's Changing Climate*, THE GLOBE AND MAIL (Aug. 3, 2011) http://www.theglobeandmail.com/news/national/hybrid-grizzly-polar-bears-a-worrisome-sign-of-the-norths-changing-climate/article589290/ (last updated Sep. 6, 2012); Christine Clisset, *Pizzly Bears*, SLATE (May 7, 2010) http://www.slate.com/articles/news_and_politics/explainer/2010/05/pizzly_bears.html. *But see* Laura Höflinger (Christopher Sultan, trans.), *In the Land of the Pizzly: As Arctic Melts, Polar and Grizzly Bears Mate*, DAS SPIEGEL (Oct. 03, 2012) http://www.spiegel.de/international/world/polar-bears-and-grizzlies-producing-hybrid-offspring-as-arctic-melts-a-859218.html.

66. Höflinger, *supra* note 65.

67. *Id*.

common as a result of this confluence.[68]

In sum, these four scenarios—discontinuity across a geographic range; cryptic or sibling species; polymorphism and sexual dimorphism; and habitat specialization—complicate taxonomy.[69] In other words, "[f]uzzy species are common, and many species are very fuzzy."[70]

C. *Incomplete Biological Information*

Incomplete biological information hinders the ability of biologists to agree on species determinations, causing taxonomic uncertainty to persist. For instance, in the 1980s, it was proposed that the fish-eating killer whales of the Antarctic represented a distinct species.[71] This was based on "differences in body size, coloration, skull morphology (including numbers of teeth), reproductive differences, and dietary differences (fish versus marine mammals)."[72] However, this was based on measurements of only three male and three female specimens.[73] Consequently, recognition of a new Antarctic species has not occurred.[74] Without analysis of skull morphology, it may take many more years before biologists accumulate enough information to either confirm or reject this theory.[75]

D. *Future Information May Cause More Uncertainty than it Resolves*

The development of higher resolution genetic analysis, together with other advances, including the rise of internet taxonomic databases complete with genetic codes and other relevant data, will likely resolve a number of debates over taxonomic status. However, this new information may also cause more issues than it resolves.

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68. *Id*.

69. MAYR, *supra* note 7, at 24.

70. HEY, *supra* note 26, at 20.

71. Krahn, M.M., et al., STATUS REVIEW OF SOUTHERN RESIDENT KILLER WHALES (*ORCINUS ORCA*) UNDER THE ENDANGERED SPECIES ACT 71 (NOAA Tech. Memo. NMFS–NWFSC–54 2002) (hereinafter "2002 Status Review").

72. *Id*.

73. *Id*. at 13.

74. *Id*.

75. *Id* at 71.

First, the future may offer *too much* information, distorting what is biologically meaningful. Too much information could also lead to greater fractionalization. Indeed, this has already occurred; speciation was once considered a "relative backwater of evolutionary biology," but beginning in the 1980s, molecular genetic tools opened the door to a flood of information.[76] In the following two decades more work on speciation was performed than over the entire period from 1859 to 1980."[77]

Second, a reexamination of previous taxonomic conclusions, aided by new technology, may indicate many species exist when scientists previously only recognized one or may group species that had previously been split. For example, many original taxonomic designations—developed by grouping individuals sharing similar characteristics and a similar location—have held through time, either because they have not been thoroughly examined or because new information has not proven them wrong; but now, the development of high resolution genetic analysis brings these prior conclusions into question.[78] Furthermore, technological developments make the discovery of many new cryptic species—genetically distinct species that have few morphological differences—possible.[79] Before genetic tests, cryptic species were usually discovered through labor-intensive research.[80] This splitting of cryptic species is likely to be controversial because of a hesitance among scientists and the public to accept a new species without an obvious morphological difference.[81]

Conversely, a reexamination of previous species designations may potentially uncover a number of groups that had been designated as species, which are in fact variations within a single species. Morphological differences between individuals within a single species, such as in sexual dimorphism, can sometimes cause a misdiagnosis. Take for

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76. COYNE & ORR, *supra* note 3, at 4–5.

77. *Id*.

78. Phil McKenna, *'Hidden' Species May Be Surprisingly Common*, NEW SCIENTIST (July 17, 2007) http://www.newscientist.com/article/dn12293-hidden-species-may-be-surprisingly-common.html.

79. *Id*.

80. MAYR & ASHLOCK, *supra* note 52, at 92–93.

81. Anna L. George and Richard L. Mayden, *Species Concepts and the Endangered Species Act: How a Valid Biological Definition of Species Enhances the Legal Protection of Biodiversity*, 45 NAT. RESOURCES J. 369, 405 (2005).

example the king parrot of the Papuan region; the males are green with an orange bill and the females are red with a black bill.[82] Taxonomists originally assigned the two sexes different species.[83] It took nearly 100 years for naturalists to realize their mistake.[84]

Third, the rise of new technology also leads to "data chauvinism."[85] "All too often the newest technology is seen as the best and the only way to gather data, instead of being seen as an alternative method to offer new insight into the group."[86] Most notably, the rise of genetic analysis has largely replaced morphological data as the preferred data in taxonomic studies.[87] But "[e]xclusive use of one type of data will not portray an accurate picture of biodiversity."[88] In short, perhaps we should become accustomed to species uncertainty—there is no reason to expect that disagreement over species boundaries will lessen in the future.

E. *The Case of the Killer Whale*

1. *Killer Whale 101*

The killer whale (*Orcinus orca*) is the largest species within the dolphin family and is the most widely distributed marine mammal, roaming between the Artic and the Antarctic in both coastal and open ocean waters.[89] They bear a striking black and white pigmentation, with a white band running the length of the whale along its bottom side, a white patch behind the eye, and a distinctive white patch called the saddle behind the dorsal fin.[90] The saddle shape varies between individuals and appears to stay the same throughout its life, aiding in the identification of individuals. Killer whales exhibit sexual dimorphism, with noticeable differences in body size, flipper

82. MAYR & ASHLOCK, *supra* note 52, at 68.

83. *Id*.

84. *Id*.

85. George & Mayden, *supra* note 81, at 403.

86. *Id*. at 403.

87. *Id*.

88. *Id*. at 405.

89. Endangered and Threatened Wildlife and Plants: Endangered Status for Southern Resident Killer Whales, 70 Fed. Reg. 69903-01 (Nov. 18, 2005) (hereinafter "2005 Listing Decision").

90. *Id*. at 69904.

size, and the height of the dorsal fin.[91]

Killer whales exhibit an unusual social structure, where individuals stay within their natal groups.[92] Normally, dispersal from a natal group helps to limit inbreeding.[93] These groups also show cooperative behavior, including coordinated predation and prey sharing.[94] Killer whales are also notable for their unique vocalizations.[95] These calls are "culturally inherited," indicating that they are learned behaviors, are stable for more than one generation (about 25 years), and differ between populations.[96]

Though officially one species, killer whales are often grouped into "ecotypes," localized populations occupying differing ecological niches.[97] This paper focuses on three ecotypes that are at the heart of a legal battle involving taxonomic uncertainty: the Eastern North Pacific (ENP) "offshores," "residents," and "transients." These three forms vary in morphology, behavior, and ecology.[98] Also, the extreme ends of their ranges overlap.[99] Finally, some evidence suggests ongoing gene flow occurs between offshores and transients with less indication of gene flow between transients and residents and residents and offshores.[100]

"*Offshores*" gain their name from spending most of their lives on the outer continental shelf (although they do visit inshore waters).[101] Compared to the other ecotypes, offshores have the largest home range.[102] Offshore group size is

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91. *Id.*

92. Michael J. Ford et al., *Inferred Paternity and Male Reproductive Success in a Killer Whale (Orinus orca) Population*, 102 J. OF HEREDITY 537, 538 (2011).

93. *Id.*

94. *Id.*

95. R. Waples & P. Clapham, *Report of the Working Group on Killer Whales as a Case Study*, *in* Report of the Workshop on Shortcoming of Cetacean Taxonomy in Relation to Needs of Conservation and Management 65 (R. R. Reeves et al., NOAA Tech. Memo. NMFS–SWFSC–363, July 2004).

96. *Id.*

97. 2005 Listing Decision, *supra* note 89, at 69905.

98. *Id.*

99. Waples & Clapham, *supra* note 95, at 66.

100. Pilot et al., *Social Cohesion Among Kin, Gene Flow Without Dispersal and the Evolution of Population Structure in the Killer Whale (Orcinus orca)*, 23 J. OF EVOLUTIONARY BIOLOGY 20, 23 (2010).

101. Waples & Clapham, *supra* note 95, at 66.

102. M. M. Krahn, et al., 2004 STATUS REVIEW OF SOUTHERN RESIDENT KILLER

considerably larger than other ecotypes, with observed groups of up to 200 whales.[103] While foraging, they are thought to feed on fish, however observation of feeding events is limited.[104] Offshores are thought to be smaller than residents or transients and have a more rounded dorsal fin.[105] Sexual dimorphism is likely less prevalent in offshores than other ecotypes.[106] Finally, offshores are also distinguishable from other ecotypes by their acoustical behavior.

"*Residents*" appear noticeably different than transients or offshores.[107] They gain their name from their residence in coastal waters reaching from Alaska to California.[108] Their dorsal fin is rounded at the tip and is falcate (curved and tapering), as opposed to rigid and straight.[109] Residents form large, stable groups (called "pods") based on matrilines ranging in size from ten to sixty whales.[110] Each pod utilizes about a dozen unique calls shared by all members.[111] Like offshores, and unlike transients, residents are primarily fish-eaters.[112] Residents are broken into three camps: Southern Residents, Northern Residents, and Alaskan Residents.

Southern Residents range from the inland waters of the Puget Sound and the Southern Georgia Strait to the coastal waters of British Columbia, Washington, Oregon, and California.[113] The Southern Resident ecotype contains three pods or family groups: J pod, K pod, and L pod.[114] Southern Residents have not been seen to associate with other resident whales. And nuclear genetic data suggests that Southern Residents rarely, if at all, interbreed with other killer whale

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WHALES (*ORCINUS ORCA*) UNDER THE ENDANGERED SPECIES ACT. 8 (NOAA Tech. Memo. NMFS–NWFSC–62, Dec. 2004) (hereinafter "2004 Status Review").

103. 2005 Listing Decision, *supra* note 89, at 69905; Waples & Clapham, *supra* note 95, at 66.

104. 2005 Listing Decision, *supra* note 89, at 69905.

105. Waples & Clapham, *supra* note 95, at 66.

106. 2004 Status Review, *supra* note 102, at 8.

107. 2005 Listing Decision, *supra* note 89, at 69905.

108. *Id*.

109. *Id*.

110. *Id*.

111. Waples & Clapham, *supra* note 95, at 65.

112. 2005 Listing Decision, *supra* note 89, at 69905.

113. *Id*.

114. *Id*.

populations.[115]

Northern Residents are found primarily in central and northern British Columbia.[116] Alaskan Residents, which are broken into two smaller communities of Southern and Western Alaskan residents, are found primarily in southeastern Alaska and the Gulf of Alaska.[117]

There are some notable behavioral or "cultural" differences between resident populations. Southern Residents, for example, have developed a unique "greeting" behavior between pods:

> The pods will form two tight lines and approach each other head on. When the groups are within 10–20 m of each other, they stop motionless at the surface and hover, facing each other for 10–30 seconds. Intermingling typically follows this greeting ceremony. Intermingling is characterized by slow-moving and tight-milling concentrations of whales. Many of the whales are in physical contact and roll and brush against each other at or near the surface.[118]

Northern Residents similarly exhibit unique behavior. They rub their bodies against rocks near shore, presumably to slough off dead skin, and steal fish from long-line fishing gear.[119]

"*Transients*" occur across the Eastern North Pacific, primarily in coastal waters.[120] A number of noticeable differences exist between transients and the other ecotypes. Morphologically, saddle patch pigmentation is restricted to three patterns, and the dorsal fin of transients tends to be more erect.[121] Transients also have the smallest pod size, consisting of fewer than ten members.[122] Lastly, transients tend to predate on other marine mammals, such as harbor seals or Dall's porpoises, as opposed to fish.[123]

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115. *Id.*
116. 2004 Status Review, *supra* note 102, at 6–7.
117. *Id.* at 7.
118. *Id.* at 9 (internal citations omitted).
119. *Id.*
120. 2005 Listing Decision, *supra* note 89, at 69905.
121. *Id.*
122. *Id.*
123. *Id.*

2. *Killer Whale Taxonomy*

Killer whales have proven to mystify taxonomic biologists for a number of years. In 1758, Carl Linnaeus first categorized the single species *Orcinus orca.*[124] Around twenty-five additional species were subsequently described; however, "a century or so of general 'lumping' of zoological species in Victorian times" resulted in the recognition of a single species.[125] This single global species consensus held until recently when new morphological and genetic information caused some to question that conclusion.[126]

Some slight differences in morphology exist between ENP ecotypes, including differences in dorsal fin shape, saddle patches, and perhaps size.[127] These slight differences in morphology do not necessarily indicate the existence of separate species.[128] It might be more appropriate to categorize these ENP ecotypes as "sibling" or "cryptic" species.

Genetically, global diversity among killer whales—including the ecotypes at issue—is relatively low.[129] Using phylogenetic modeling, it is clear that residents and offshores are on a different "clade," or a branch of a family tree, than transients.[130] (ENP offshores and transients are actually more closely related to other fish-eaters in the *Atlantic* Ocean than they are to ENP transients.)[131] The fact that purported morphological differences correspond to genetic differences between ecotypes supports this claim.

Among ENP ecotypes, "[t]he issue of whether any

124. 2004 Status Review, *supra* note 102, at 16.

125. *Id*.

126. *Id*.

127. For example, offshore dorsal fin shape is unique, their saddle patch somewhat resembles resdients, and their body size is thought to be somewhat smaller than other ENP ecotypes. *See* Waples & Clapham, *supra* note 95, at 67.

128. *Id*.

129. A. Rus Hoelzel et al., *Low Worldwide Genetic Diversity in the Killer Whale (Orcinus orca): Implications for Demographic History*, 269 PROCEEDINGS OF THE ROYAL SOCIETY OF LONDON 1467 (2002).

130. Phillip A. Morin et al., *Complete Mitochondrial Genome Phylogeographic Analysis of Killer Whale (Orcinus orca) Indicates Multiple Species*, 20 GENOME RES. 908 (2010).

131. Andrew D. Foote et al., *Out of the Pacific and Back Again: Insights into the Matrilineal History of Pacific Killer Whale Ecotypes*, 6 PLoS One (2011), available at http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0024980; Morin, *supra* note 130.

contemporary gene flow occurs among [ecotypes] remains unresolved."[132] Available data suggests either low levels of gene flow (a few mating events per generation) or relatively recent divergence, occurring in the last several-hundred to several-thousand years.[133] The nature and amount of interbreeding is obviously important to a discussion of whether there is a single species or multiple species. Interbreeding would tend to homogenize genetic differences. If there was historic divergence between ecotypes—that is, supposing that the various ecotypes were once on different evolutionary paths—recent interbreeding could undo that historic divergence.[134]

Many have observed that the behavioral or "cultural" differences between ecotypes act as an isolating mechanism.[135] Prey specialization and vocalization makes it difficult for an individual to switch ecotypes (known as dispersal), and relegates interbreeding to chance encounters when ecotypes meet because of their overlapping ranges.[136] But due to different temporal and spatial habitat use, caused in part by prey specialization, these chance encounters may be minimal, limiting inter-ecotype gene flow.[137] If these cultural differences act as isolating mechanisms, reducing the homogenizing effect of gene flow, it is not clear whether such barriers are sufficient to diagnose them as separate species. It is plausible that such cultural differences between ecotypes are ephemeral, suggesting changing environments could lead to new patterns of population structure.[138]

So, are these ecotypes one species or more? It depends on who you ask. Arguments for a single species include the

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132. 2004 Status Review, *supra* note 102, at 16.

133. 2004 Status Review, *supra* note 102, at 16; A. Rus Hoelzel, Report on Killer Whale Population Genetics for the BRT Review on the Status of the Southern Resident Population (unpublished) 2004, available at http://www.nwfsc.noaa.gov/research/divisions/cb/ecosystem/marinemammal/documents/hoelzel_population_genetics.pdf (hereinafter "BRT Report"). Hoelzel notes, "The most parsimonious interpretation seems to be that there is ongoing or at least very recent male-mediated geneflow among the populations in the North Pacific, including between transients and residents."

134. *See* MAYR, *supra* note 7, at 118.

135. Pilot et al., *supra* note 100; BRT Report, *supra* note 133.

136. Pilot et al., *supra* note 100, at 27–28.

137. BRT Report, *supra* note 133.

138. *Id*.

following, among other things:

- Eastern North Pacific ecotypes are sympatric (have overlapping ranges). Normally, mammal species cannot undergo sympatric speciation.[139]
- Genetic divergence between residents, transients, and offshores is relatively shallow. This could indicate divergence and incomplete speciation, or it could reflect some historic variation, which is now receding. (A small amount of interbreeding might dampen some ancient divergence).[140]
- "Cultural" variations between ecotypes, such as foraging specialization or vocalizations, could be learned behaviors, and therefore might be poor indicators of species difference.[141]
- mtDNA data (genetic information inherited from the mother's side) may give an incomplete picture of the evolutionary history of ecotypes. Most of the studies of killer whale genetics have focused on mtDNA.[142]
- Alleged morphological differences are largely observational. Until more quantifiable data is available, such as skull measurements, it would be premature to find another species. Much of this information, such as skull measurements, is unfortunately difficult to obtain.[143]
- Morphological differences do not necessarily reflect speciation.

There are equally compelling arguments for multiple species. These include, *inter alia*:

- Purported differences in morphology (saddle patch patterns; dorsal fin shape; body size), acoustic patterns, and behavioral specializations (prey preferences; meeting rituals; rock rubbing) are congruent with patterns of genetic variation.[144]
- Although the ecotypes demonstrate genetic similarities, these similarities are not necessarily recent. Furthermore, no evidence of movement of individuals between ecotypes

139. Waples & Clapham, *supra* note 95, at 69.

140. *Id.*

141. *Id.* at 71.

142. *Id.* at 70–71.

143. *Id.* at 71.

144. *Id.*

exists. For example, no resident has left her pod to become a transient.[145]

- While ENP killer whales have overlapping ranges that would typically act to prevent speciation, there is evidence to suggest that ENP residents and offshores diverged from ENP transients while physically isolated. Based on the genetic similarity between ENP residents and offshores and other fish-eating killer whale populations in the North Atlantic, some have suggested that between ice ages a population of Pacific killer whales migrated to the Atlantic where they were subsequently stranded by another ice age. Here, given their small population, speciation could occur with greater speed (known as a "founder effect"). When glaciers melted again, some killer whales from the North Atlantic traveled back to the Pacific.[146]

In 2004, the National Marine Fisheries Service (NMFS) hosted a conference on cetacean taxonomy. At the conference, the NMFS scientists informally voted on whether the ENP ecotypes constituted separate species.[147] Of the seventeen participants, six felt that killer whales were a single species and that this designation would remain valid even when additional evidence becomes available.[148] These six single species advocates relied on the BSC and a phylogenetic species concept.[149] One person felt that multiple species exist and that current evidence supported that conclusion.[150] Ten participants felt that multiple species probably exist and that this might be confirmed by future evidence.[151] The accompanying report notes those who supported a single-species and those who supported multiple-species based their opinion on the BSC.[152]

The voting results help to illuminate the role that species concepts play. While the application of a phylogenetic species concept generally results in the recognition of more species than the BSC, here all multiple species advocates relied on the BSC, and some single-species advocate(s) based their

145. *Id.*

146. *See* Foote et al., *supra* note 131.

147. Waples & Clapham, *supra* note 95, at 72.

148. *Id.*

149. *Id.*

150. *Id.*

151. *Id.*

152. *Id.*

conclusion on the phylogenetic species concept. Further, the employment of single species concept can produce multiple results. One person thought multiple species definitively existed, and another thought the evidence available suggested only a single species of ENP killer whale exists.[153]

Since 2004, some killer whale experts have publicly announced that they support multiple species in the Eastern North Pacific. In 2010, Morin endorsed two Antarctic ecotypes and ENP transients being raised to full species status.[154] In 2012, killer whale taxonomy was in the news when biologist John K. B. Ford began pushing publically for the recognition of transient killer whales as a separate species.[155] Also in 2012, the Society for Marine Mammalogy, a professional organization dedicated to the study of marine mammals, officially recognized that ENP residents and transients as an unnamed subspecies of *Orcinus orca*.[156]

II. SPECIES IN LAW: THE ENDANGERED SPECIES ACT AND TAXONOMIC UNCERTAINTY

A. *Legal "Species"*

The Endangered Species Act (ESA) protects "species." But, the statutory definition of "species" is expansive and goes beyond what would traditionally be recognized as biological species. As defined by the Act, "[t]he term 'species' includes 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."[157] By protecting subspecies and distinct population segments (DPS), the ESA protects

153. *Id*.

154. Morin et al., *supra* note 130.

155. Ford proposed naming the new species "Biggs killer whales" in honor of the late Michael Biggs, a killer whale researcher whose research first led to the identification of transient whales. Dan Joling, *Scientists Want New Name for Mammal-Eating Orcas*, THE SEATTLE TIMES (Nov. 25, 2012) http://seattletimes.com/html/localnews/2019762075_apakkillerwhalename1stldwritethru.html.

156. *See* SOCIETY FOR MARINE MAMMALOGY, List of Marine Mammal Species and Subspecies, http://www.marinemammalscience.org/index.php?option=com_content&view=article&id=645&Itemid=340 (last visited April 15, 2014).

157. 16 U.S.C. § 1532(16) (2012).

biodiversity below the species level. The inclusion of DPS into the ESA, a non-biological term introduced by Congress, can be traced to the Marine Mammal Protection Act, which protected "population stocks" in addition to species.[158] Professor Holly Doremus notes that the inclusion of "population stocks" was "primarily to ensure protection of Alaskan polar bears in the face of disagreement in the scientific community over whether Alaskan bears belonged to a separate subspecies than other arctic bears."[159] In other words, the DPS category can be traced to an attempt to deal with a problem of taxonomic uncertainty.

Not all were pleased with this broad statutory definition in the ESA. Shortly after the inclusion of the DPS category in the statutory definition of a species in 1978, the General Accounting Office issued a report critical of the definition.[160] The report expressed concern that the DPS category was overly inclusive and could lead to absurd results, such as the listing of a population of squirrels that resided in a city park whose population was declining despite the abundance of other squirrels of the same species in other parks nearby.[161] The Senate Committee on Environment and Public Works acknowledged the concerns of the General Accounting Office but also pointed out that the Fish and Wildlife Service (FWS) and NMFS were opposed to getting rid of the DPS category for fear of reduced flexibility in the Act.[162] The Senate Committee acknowledged that DPS listings might provide a "great potential for abuse," however it noted that it expected that the administering agencies "list populations sparingly and only when the biological evidence indicates that such action is warranted."[163]

Congress also considered and rejected an attempt to adopt a single species concept. In the ESA amendments of 1978, the House passed an amendment to the Act which would have adopted a strict BSC as the definition of species—restricting

158. Holly Doremus, *Listing Decisions Under the Endangered Species Act: Why Better Science Isn't Always Better Policy*, 75 WASH. U. L. Q. 1029, 1093 (1997).

159. *Id*. at 1093–94.

160. U.S. GENERAL ACCOUNTING OFFICE, CED-79-65, ENDANGERED SPECIES: A CONTROVERSIAL ISSUE NEEDING RESOLUTION (1979) *available at* http://www.gao.gov/assets/130/127285.pdf.

161. *Id*. at 52.

162. S. COMM. REP. NO. 96-151, at 1397 (1979).

163. *Id*.

"species" to "a group of fish, wildlife, or plants, consisting of physically similar organisms capable of interbreeding but generally incapable of producing fertile offspring through breeding with organisms outside this group."[164] The Senate, however, rejected a similar proposal.[165] The Conference Committee ultimately arrived at the current definition of species, which includes DPS.[166]

Between 1978 and 1991, the FWS and NMFS did not attempt to provide a regulatory definition for "species," "subspecies," or "distinct population segments." A series of petitions to list salmonids in the early 1990s and accompanying taxonomic uncertainty over Pacific coast salmonids would ultimately supply the inspiration needed for agency action.

Salmonid taxonomy is complicated. Salmonids spawn in freshwater. Some species contain both anadromous (ocean-going) and non-anadromous (freshwater residents) populations.[167] For the ocean-going fish, most return to the freshwater in which they were born at particular times (called runs).[168] These runs act as an isolating mechanism, reducing gene flow between populations. Different freshwater bodies provide physical isolating barriers.[169] Even when two populations share the same physical area, temporal differences in run times may also act as an isolating mechanism.[170] However, these mechanisms are not perfect. "With Pacific salmon, reproductive isolation is seldom a black-and-white situation; rather, it is a question of degree. Although the homing instinct is well documented in these species, natural straying does occur, and anadromous spawning populations that are completely isolated from other conspecific populations are probably rare."[171]

To deal with these issues, Robin Waples, a staff biologist with NMFS, attempted to flush out a working definition of a

164. H.R. REP. NO. 14104, 95th Cong. (2d Sess. 1978).

165. S. 2899, 95th Cong. (2d Sess. 1978).

166. H.R. CONF. REP. 95-1804, at 2 (1978).

167. Robin Waples, *Pacific Salmon, Oncorhynchus spp., and the Definition of "Species" Under the Endangered Species Act*, 53 MARINE FISHERIES REV. 11, 16 (1991).

168. *Id*. at 13–16.

169. *Id*. at 13.

170. *Id*. at 16.

171. *Id*. at 13.

DPS.[172] He reasoned that for a population to be "distinct" it must represent an "evolutionary significant unit" (ESU). An ESU is a population that: (1) "Is substantially reproductively isolated from other conspecific population units"; and (2) "Represents an important component in the evolutionary legacy of the species."[173] In 1991, NMFS adopted Waples' ESU definition for the listing of Pacific salmonids.[174]

In 1996, FWS and NMFS jointly defined DPS for all other vertebrate species, not just Pacific salmonids.[175] This definition was inspired by, and is markedly similar to, the definition for an ESU. For a population to be listed as a DPS, it must be "discrete" and "significant."[176] To meet the "discrete" prong, the population must be "markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors" or be "delimited by international governmental boundaries within which" there are differences in conservation policy.[177] To be "significant," the population must: (1) persist "in an ecological setting unusual or unique for the taxon"; (2) loss of the population "would result in a significant gap in the range of a taxon"; (3) the population "represents the only surviving natural occurrence of a taxon"; *or* (4) the population "differs markedly from other populations of the species in its genetic characteristics."[178]

The flexibility of the DPS category has greatly eased issues resulting from taxonomic uncertainty. It can be used as a stop-gap measure, allowing for the protection of taxonomically uncertain populations until further research may be performed.[179] To be listed as a DPS does not require a general

172. See *id*.

173. *Id*. at 12.

174. Policy on Applying the Definition of Species Under the Endangered Species Act to Pacific Salmon, 56 Fed. Reg. 58, 612 (Nov. 20, 1991).

175. Policy Regarding the Recognition of Distinct Vertebrate Population Segments Under the Endangered Species Act, 61 Fed. Reg. 4722 (Feb. 7, 1996).

176. *Id*. at 4725.

177. *Id*.

178. *Id*.

179. Alternatively, FWS has attempted to use the DPS listing to break a species into smaller populations and then delist these smaller populations. For one account of this strategy in action against the gray wolf, see Nicole M. Tadano, *Piecemeal Delisting: Designating Distinct Population Segments for the Purpose of Delisting Gray Wolf Populations is Arbitrary and Capricious*, 82 WASH. L. REV. 795 (2007).

consensus about whether some population is actually a species or subspecies. Rather, the population needs to be discrete and significant. Generally speaking, if there is a real question of whether a population may constitute a species or subspecies, that population will likely be "discrete" and "significant." For that reason, since the introduction of the ESU/DPS definitions, the use of these listing types has jumped dramatically, particularly for "fuzzy" taxonomic groups such as fish.[180]

B. *Best Available Science Mandate*

In 1982, in an attempt to prevent non-biological considerations, such as cost-benefit analysis, from impacting listing decisions[181] Congress imposed new requirements, including that all listing decisions be made "solely" on the basis of the best available scientific and commercial evidence.[182] For all listing, delisting, or reclassification decisions, "[i]n determining whether a particular taxon or population is a species for the purposes of the Act, the Secretary shall rely on standard taxonomic distinctions and the biological expertise of the Department and the scientific community concerning the relevant taxonomic group."[183]

The best available science requirement doesn't require perfect knowledge. Rather it requires consideration of the *best* knowledge available. In the words of the D.C. District Court, "The statutory standard, requiring that agency decisions be made on the 'best scientific and commercial data available', rather than absolute scientific certainty, is in keeping with congressional intent" that the agencies "take preventive measures before a species is conclusively headed for extinction."[184]

Standard rules of agency deference also give legal cover to agency decisions in areas of uncertainty. As the Supreme

180. Susan M. Haig, et al., *Taxonomic Considerations in Listing Subspecies Under the U.S. Endangered Species Act*, 20 CONSERVATION BIOLOGY 1584, 1588 (2006) (noting that thirty-one percent of all fish listings are as DPS resulting in more listings of populations than subspecies.)

181. Doremus, *supra* note 158, at 1054–55.

182. Endangered Species Act Amendment of 1982, Pub. L. No 97-304, 96 Stat. 1411 (1982). *See also*, 16 U.S.C. 1533(b)(1)(a).

183. 50 C.F.R. 424.11 (2012).

184. Defenders of Wildlife v. Babbitt, 958 F. Supp. 670, 679-80 (D.D.C. 1997). *See also*, American Wildlands v. Norton, 193 F. Supp. 2d 244, 251 (D.D.C. 2002) (same).

Court has held, "When specialists express conflicting views, an agency must have discretion to rely on the reasonable opinions of its own qualified experts even if, as an original matter, a court might find contrary views more persuasive."[185]

C. *Legal History of the Southern Resident Killer Whales*

In May 2001, the Center for Biological Diversity (CBD) and eleven others petitioned for the listing of Southern Resident killer whales (pods J, K, and L) as a DPS under the ESA.[186] CBD justified listing as a DPS because of physical, physiological, ecological factors, and behavioral differences between resident and transient populations generally in the northeastern Pacific, and specially between Southern and Northern Residents.[187]

On August 13, 2001, NMFS announced that listing may be warranted and requested information to assist with a status review.[188] NMFS assembled a Biological Review Team (BRT) of internal NMFS scientists to develop the status review. The eleven scientists represented specialists in genetics, risk management, risk modeling, contaminants, toxicology, marine mammal biology, habitat, foraging ecology, photo identification, and whale watching.[189] This group of scientists reviewed the available scientific and commercial data to produce a "status report" from which the agency decision-maker was to make his determination.

The 2002 status review notes that "currently, only one species of killer whales (*O. orca*) is globally recognized."[190] However, "accumulating evidence suggests that the currently recognized global species of killer whales may need to be divided into multiple species."[191] The BRT noted that deciding

185. Marsh v. Oregon Natural Res. Council, 490 U.S. 360, 378 (1989).

186. CENTER FOR BIOLOGICAL DIVERSITY, PETITION TO LIST THE SOUTHERN RESIDENT KILLER WHALE (*ORCINUS ORCA*) AS AN ENDANGERED SPECIES UNDER THE ENDANGERED SPECIES ACT (May 1, 2001), available at: http://www.biologicaldiversity.org/species/mammals/Puget_Sound_killer_whale/pdfs/petition.pdf.

187. *Id*. at 7–16.

188. Listing Endangered and Threatened Species and Designating Critical Habitat: Petition To List Southern Resident Killer Whales, 66 Fed. Reg. 42499 (Aug. 13, 2001).

189. 2002 Status Review, *supra* note 71, at 1.

190. *Id*. at 71.

191. *Id*.

whether the differences between residents and transients were profound enough to warrant separate species was going to be controversial and that this taxonomic uncertainty is "characteristic of marine mammals."[192] Ultimately the BRT concluded that "there are unrecognized species or subspecies of killer whales within the [global species]",[193] and likely between residents and transients in the North Pacific given the "striking genetic differences" and behavioral differences, particularly prey specialization.[194] But the BRT refused to draw the new lines.

NMFS was put in a pickle. The status review did not decide which taxon the Southern Residents belong to, noting only that a single global species which did not recognize any subspecies was wrong. Given the lack of better knowledge, on July 1, 2002, the agency found that listing was not warranted at that time because under the only currently recognized species the Southern Residents were not a distinct population segment.[195] The agency did admit that it was "concerned about the recent decline in Southern Resident assemblage" and would reconsider the taxonomy of the killer whale within four years.[196]

In *Center for Biological Diversity v. Lohn*, the district court held that NMFS' reliance on a single global species was flawed.[197] A new twelve month finding was ordered.[198]

In response, NMFS held a workshop in 2004 to discuss the "shortcomings of current cetacean taxonomy in terms of management needs."[199] The workshop included a working group on the killer whale taxonomy to be used as a case study.[200] The group, composed of eighteen members, examined

192. *Id*. at 72.

193. *Id*. at 85.

194. *Id*. at 71–72.

195. Endangered and Threatened Wildlife and Plants: 12-Month Finding for a Petition To List Southern Resident Killer Whales as Threatened or Endangered Under the Endangered Species Act (ESA), 67 Fed. Reg. 44133-01 (July 1, 2002).

196. *Id*. at 44138.

197. *See* Ctr. for Biological Diversity v. Lohn, 296 F. Supp. 2d 1223, 1227 (W.D. Wash. 2003) vacated and remanded, 511 F.3d 960 (9th Cir. 2007).

198. *Id*. at 1243.

199. R. R. REEVES ET AL., EDS., REPORT OF THE WORKSHOP ON SHORTCOMING OF CETACEAN TAXONOMY IN RELATION TO NEEDS OF CONSERVATION AND MANAGEMENT 4 (NOAA Tech. Memo. NMFS–SWFSC–363, July 2004).

200. *Id*.

the taxonomic quandary of the Eastern North Pacific killer whale ecotypes.[201] After a full investigation, the working group could not agree on whether the killer whales constituted a single species, multiple species, or different subspecies. A majority of the participants felt that residents and transients likely represented different species or subspecies, although the discussion of subspecies was mired in disagreements about the validity of subspecies as a taxonomic unit and whether subspecies should be discussed without an explicit definition of the term.[202]

The workshop on cetacean taxonomy, in particular the efforts of the killer whale working group, were highly influential in the 2004 status review required by the court in *Lohn*. Reviewing the scientific record, the 2004 BRT "reached consensus that—although multiple species may exist and may be confirmed in the future—the present data are not adequate to support designation of any new species. In particular, the BRT concluded that, provisionally, North Pacific transients and residents should be considered to belong to a single species,"[203] but "the BRT decided that the taxon to use for determining a DPS under the ESA should be the North Pacific residents, an unnamed subspecies of *O. orca*."[204] In determining that the residents should be distinguished as a subspecies, the BRT found important that: (1) the genetic differences between transients and residents were more significant than differences within the resident population; (2) the ecotypes rested on different branches (or "clades") of a detailed phylogenetic tree; (3) that interbreeding between the two groups had not been observed; and (4) objective morphological differences had been observed (though the sample size was low).[205]

In 2004, based on the findings of the recent status review, NMFS published a proposed rule to list the Southern Residents as threatened.[206] On November 18, 2005, NMFS

201. Waples & Clapham, *supra* note 95.

202. *Id*. at 71–72.

203. 2004 Status Review, *supra* note 102, at 39.

204. *Id*. at 41.

205. *Id*. at 39–40.

206. Endangered and Threatened Wildlife and Plants: Proposed Threatened Status for Southern Resident Killer Whales, 69 Fed. Reg. 76673 (Dec. 22, 2004).

officially listed the Southern Residents as an endangered "species."[207] Or, to be more specific, NMFS recognized the Southern Residents as a DPS of the ENP resident subspecies (as accepted in the 2004 status review).[208]

Subsequently, in 2012, The Pacific Legal Foundation (PLF), filed a petition to delist the Southern Residents because, among other things, they contended that there was no scientific basis to determine that ENP residents constitute a subspecies of the single recognized killer whale species.[209]

NMFS took PLF's petition under consideration, and after issuing a ninety-day finding that PLF's petition may be warranted,[210] ultimately, denied the petition to delist, finding:

> After reviewing information in the petition, the public comments, and the scientific literature published in the 9 years since the 2004 status review, we find no new information that leads to a different conclusion from that reached in the 2005 rulemaking, and the weight of evidence continues to support our conclusion that the North Pacific [r]esident killer whales represent a taxonomic subspecies.[211]

After over a decade of litigation and administrative processes, the Southern Resident killer whales are currently legally recognized as a DPS of the ENP resident subspecies.

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207. Endangered and Threatened Wildlife and Plants: Endangered Status for Southern Resident Killer Whales, 70 Fed Reg. 69903 (Nov. 18, 2005).

208. *Id*. at 69907.

209. PACIFIC LEGAL FOUNDATION, PETITION OF THE CENTER FOR ENVIRONMENTAL SCIENCE, ACCURACY & RELIABILITY, EMPRESAS DEL BOSQUE, AND COBURN RANCH TO DELIST THE SOUTHERN RESIDENT KILLER WHALE DISTINCT POPULATION SEGMENT UNDER THE ENDANGERED SPECIES ACT (Aug. 1, 2012), available at http://www.pacificlegal.org/old-site/document.doc?id=651 (Hereinafter "2012 Petition to Delist").

210. Listing Endangered or Threatened Species: 90-Day Finding on a Petition To Delist the Southern Resident Killer Whale; Request for Information, 77 Fed. Reg. 70733 (Nov. 27, 2012).

211. Listing Endangered or Threatened Species: 12-Month Finding on a Petition To Delist the Southern Resident Killer Whale 78 Fed. Reg. 47277, 47280 (Aug. 5, 2013).

III. CONSEQUENCES OF CLASH BETWEEN SCIENTIFIC AND LEGAL SPECIES

A. *Is Uncertainty in the Law Undermining the Objectivity of Science?*

The Endangered Species Act contemplates that science will impact the law. Traditionally conceived, science will tell decision-makers what species are in peril, and those decision-makers in turn will have a nondiscretionary duty to list those species to protect them. But some have suggested that the opposite may be occurring—that the law is influencing scientists as they are making biological determination.[212] The past few decades have seen an increase in the number of recognized species and subspecies. Some of this increase is due to new discoveries or data. But many newly found species were the product of a shift in species concept—splitting a single species into multiple new species or raising previously recognized subspecies to the species level.[213] This phenomenon has become known as "taxonomic inflation" by critics.[214]

Taxonomic inflation is most often facilitated from a switch in species concepts from the BSC to a phylogenetic species concept.[215] As discussed earlier, phylogenetic species concepts generally recognize more species because they are not as stringent as the BSC.[216] Madagascar's lemurs provide an excellent example of this phenomenon: in 1982, scientists recognized only thirty-six lemur species, but now recognize approximately eighty-three.[217] This increase is largely a result of the movement towards more expansive phylogenetic species concepts. [218]

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212. *See* Nick J.B. Isaac et al., *Taxonomic inflation: its influence on macroecology and conservation*, 19 TRENDS IN ECOLOGY & EVOLUTION 464 (2004); 2012 Petition to Delist, *supra* note 209, at 11–13.

213. *See* discussion *supra* section I.A.2.

214. Isaac et al., *supra* note 212. Isaac et al. define "taxonomic inflation" as when "known subspecies are raised to species as a result in a change in species concept, rather than to new discoveries."

215. *See* Ian Tattersall, *Madagascar's Lemurs: Cryptic Diversity or Taxonomic Inflation?*, 16 EVOLUTIONARY ANTHROPOLOGY 12, 21 (2007); Isaac et al., *supra* note 212, at 465 box 1.

216. *See* discussion *supra* section I.A.2.

217. Tattersall, *supra* note 215, at 13 table 1.

218. *Id*. at 21.

There are multiple theoretical reasons why conservation-minded scientists may be consciously or unconsciously raising populations to DPS ranks, DPS to subspecies, or subspecies to species. First, "although some national and international legal instruments extend protections to taxonomic units below the level of species, many do not. Taxa of species rank are still the primary currency for conserving and managing biodiversity."[219] Even in countries like the United States, that protect biodiversity below the species level, the protection of a species will be given greater political and emotional weight than lower taxa.[220] The extinction of species is an easy concept to understand and one that emotionally speaks to many Americans, whereas the extirpation or extinction of a subspecies or some taxa below subspecies does not carry the same clout.[221] Though the listing of endangered species should be dispassionate—if a species is endangered, it should be listed—this emotional argument caries political clout.[222] In this way, listing a species is potentially easier and a safer political path for the agencies than listing a subspecies or DPS.[223]

Second, by fragmenting a single species into multiple distinct species, scientists can work the "numbers game." In splitting a species into multiple species, each resulting species has fewer members.[224] Furthermore, these new species would likely have smaller ranges, making them more susceptible to extinction (and therefore listing) under the ESA.[225] For example, the frog species *Rana pipiens* has been split from a single species to over two dozen species.[226] One of these new species, the Chiricahua leopard frog, has benefited from this split.[227] Because of the risk of extirpation, the frog has been

219. Cracraft, *supra* note 21, at 337.

220. *Id.*

221. *See id.*; *Species Inflation: Hail Linnaeus,* THE ECONOMIST, May 17, 2007, http://www.economist.com/node/9191545 (hereinafter "*Hail Linnaeus*").

222. *See* Cracraft, *supra* note 21, at 337; *Hail Linnaeus*, *supra* note 221.

223. *Hail Linnaeus*, *supra* note 221.

224. *Id.*

225. Haig et al., *supra* note 180.

226. W.R. Morrison III et al., *The Impact of Taxonomic Change On Conservation: Does It Kill, Can It Save, or Is It Just Irrelevant?* 142 BIOLOGICAL CONSERVATION 3201, 3202 (2009).

227. *Id.*

listed under the ESA. As a consequence of listing, over 30,000 hectares of private land have been put into conservation easements.[228]

Third, outside the ESA, taxonomic inflation also promotes conservation by raising the biological diversity of a piece of habitat, providing a claim for protection under other federal or state laws.[229] Joel Cracraft, a prominent supporter of the PSC, touts the political ramifications of a switch to a PSC concept. He notes that "[m]any countries and conservation organizations are currently concerned with creating protected areas and ecosystem management ones using measures of endism to set priorities."[230] Cracraft argues that the PSC helps to more accurately identify areas of high biodiversity, improving their odds at protection.[231]

Taxonomic inflation may be a concern for conservationists as well. In the short-term, taxonomic inflation may result in more listings. But in the long-term, effects are less promising:

> [A]s every economist knows, inflation brings devaluation. Rarity is not merely determined by the number of individuals in a species, it is also about how unusual that species is. If there are only two species of elephant, African and Indian, losing one matters a lot. Subdivide the African population, as some taxonomists propose, and perceptions of scarcity may shift.[232]

To some prominent scientists, however, taxonomic inflation sounds a whole lot like "sour grapes"—a modern rehashing of the historic debate between "lumpers" and "splitters."[233] Now, however, the stakes have been raised. Instead of merely alleging that a person's species determinations do not adhere to the evidence—a relatively light charge given that disagreement does not necessarily mean disrespect—here, the accusation is acrid. By alleging taxonomic inflation, the accuser is asserting that either the taxonomist in question either was unprofessional by unintentionally allowing personal biases to affect taxonomic decisions, or worse, that the

228. *Id.*

229. *Hail Linnaeus*, *supra* note 221.

230. Cracraft, *supra* note 21, at 336.

231. *Id.*

232. *Hail Linnaeus*, *supra* note 221.

233. Isaac et al., *supra* note 212, at 464.

taxonomist is unscrupulous, intentionally fixing taxonomic determinations for the purposes of gaming conservation laws.

Charges of taxonomic inflation may be overblown as well. Taxonomic inflation is concerned only with taxonomic changes which result in more listings. But not all changes in taxonomic classifications result in more listings. One study of the legal implications of taxonomic change "found that [in general] changes in taxonomy do not have consistent and predictable impacts on conservation."[234] As discussed above, future changes in taxonomy will likely "lump" multiple species together into a single species and will "split" a single species into multiple species. While "splitting" generally encourages greater legal protection, "[t]axonomic change has least impact on the protection of iconic or charismatic organisms, protected areas of special status, and economically important groups."[235] This finding runs counter to a suggestion that taxonomic changes are politically motivated; rather, the change is a natural expression of change in scientific thought.[236]

B. *Are We Relying Too Heavily on DPS Listings?*

The flexibility of the DPS is a definitive strength of the ESA. Where there is taxonomic uncertainty, the DPS "species" is convenient because it does not require a definitive taxonomic determination. Rather, the DPS must only be "distinct" from the larger species, and "significant" to the population as a whole.[237] This flexibility allows for listing of "fuzzy" species, where speciation is incomplete. It also allows for listing where there is incomplete information. Changes to a taxonomic status often take many years (if not decades) to be accepted. An initial proposal to split a species is often followed by years of additional research. In the interim period, before any definitive conclusion can be made, the proposed species can be protected. In this way, the DPS is a kind of safety valve, allowing listing when it might otherwise be defeated.

As discussed earlier, the ESA allows for the listing of DPS, a taxonomic unit below subspecies. Congress' decision to protect

234. Morrison et al., *supra* note 226, at 3205.

235. *Id*.

236. *Id*.

237. See *supra* note 175 and accompanying text.

biodiversity at this level was controversial and generated a rebuke from the General Accounting Office.[238] In reaction to controversy regarding the authorization of listing DPS, Congress indicated that such listings should be used "sparingly."[239] Some have questioned whether FWS and NMFS are abusing the DPS listing, in violation of Congress' directive. Russell Brooks, of the property rights group Pacific Legal Foundation, argued that since the adoption of the regulatory definition of DPS, "federal agencies have apparently ignored Congress's command to use [DPS] listings 'sparingly.'"[240] For example, 31% of fish listings are at the DPS level.[241] There is also anecdotal evidence that more recent listings for other groups, such as mammals, have been heavily focused at the DPS level. [242]

These claims, however, largely lack merit. First, an increase in DPS listing is common sense. Early listings presumably focused on species, as opposed to DPS, as these were the proverbial low-hanging fruit: they were the groups most apparent and historically endangered. As these were listed, conservation efforts aimed at preserving biodiversity could focus on or shift to subspecies or DPS.

Second, the Pacific Legal Foundation, and others, overemphasize Congress' supposed mandate to use the DPS criteria "sparingly." This statement, as a matter of Congressional intent, should be afforded little, if any, weight. As recalled earlier, the "sparingly" statement was made by a Senate committee in declining to amend the ESA. This does not tell us anything about the intent of Congress when first creating the DPS category—the "sparingly" caveat could represent the true intent of the legislature or it could be a post-hoc rationalization. As the Supreme Court has noted, "Such post hoc statements of a congressional Committee are not

238. *See* discussion *supra* Part II.A.

239. *Id*.

240. Leslie Marshall Lewallen & Russell C. Brooks, *Alsea Valley Alliance v. Evans and the Meaning of "Species" Under the Endangered Species Act: A Return to Congressional Intent*, 25 SEATTLE U. L. REV. 731, 743 (2002); Blake Hood, *Transgenic Salmon and the Definition of "Species" Under the Endangered Species Act*, 18 J. LAND USE & ENVT'L L. 75, 91 (2002).

241. Haig et al., *supra* note 180, at 1588.

242. *Id*.

entitled to much weight."[243]

IV. CONCLUSION: EMBRACE UNCERTAINTY (BECAUSE WE ARE NOT GETTING RID OF IT ANYTIME SOON)

Taxonomic uncertainty is unavoidable in science. Speciation does not provide neat dividing lines. Therefore "species," as a biological meaningful unit, may be "fuzzy." Further, discrete scientific disciplines, with their differing aims, objectives, and areas of study, have caused a proliferation of diverse species concepts to serve their differing needs.

In response, some have suggested that the ESA define "species" using a single species concept.[244] In doing so, the thought being, listings would be more consistent because all species determinations would be determined by the same set of rules. Such proposals, however, are both unrealistic and potentially undesirable.

Determining just which species definition to adopt would be highly controversial. Lawmakers would effectively be asked to pick a winner in a scientific dispute, for which there is no reasonable expectation of an end, something traditionally eschewed. Further, any proposed modification of the ESA is met with great hostility from the environmental community (as most proposed modifications seek to curtail the reach or power of the Act). Instead of fighting uncertainty, we should embrace it and figure out ways to coexist harmoniously.

As species pluralism, both in science and the law, might be an unavoidable reality, we should make this our starting point—how can we live with a system that recognizes multiple species concepts. Practically, the case of the Southern Resident killer whales and the hard work of the NMFS scientists provide a vital example of how to deal with uncertainty head on.

In assessing killer whale taxonomy, NMFS scientists

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243. Weinberger v. Rossi, 456 U.S. 25, 35 (1982).

244. *Compare* Kevin D. Hill, *The Endangered Species Act: What Do We Mean by Species*? 20 B.C. ENVT'L AFF. L. REV. 239, 263 (1993) (advocating the law adopt the BSC) *with* Paul Z. Goldstein et al., *Conservation Genetics at the Species Boundary*, 14 CONSERVATION BIOLOGY 120, 129 (Feb. 2000) (advocating generally that conservation purposes are best served by a phylogenetic species concept).

gathered virtually everything that had previously been written on the subject, invited scientists to produce further research on the subject, and after an exhaustive review, gathered to discuss both what was known and what was not known. In doing so, NMFS created a transparent record of their account. Where uncertainty existed, they debated both sides, creating a record of the science in favor of multiple species, that in favor of a single species, and perhaps most importantly, the work that could be done in the future to resolve taxonomic issues. Included in this review was an open acknowledgement of the species concept each scientist considered appropriate given the circumstances. After this thorough process, the agency scientists voted on the Southern Resident taxonomy based on the then available evidence. While some disagreed, and still disagree, with the group decision, the thoroughness and transparency of the record makes the uncertainty perhaps more palatable. Maybe that is enough.