

1-1-2011

Spineless Wonders: How Listing Marine Invertebrates and Their Larvae Challenges the U.S. Endangered Species Act

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Articles

**Spineless Wonders: How Listing Marine
Invertebrates and Their Larvae Challenges
the U.S. Endangered Species Act**

Ryan P. Kelly¹

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| I. | INTRODUCTION: WHY THE BIOLOGY OF RECENTLY-LISTED SPECIES CHALLENGES THE INTERPRETATION AND APPLICATION OF THE ENDANGERED SPECIES ACT | |

In recent years, four species of marine invertebrates have been added to the list of those protected under the U.S. Endangered Species Act of 1973 (“ESA” or “Act”).² These ocean-dwelling species, which lack backbones and often have complex lifecycles with multiple larval stages, challenge federal agencies’ interpretation and application of the

2. 16 U.S.C. §§ 1531-1544 (2006).

ESA, potentially eroding the Act's protections for the species' survival and recovery. In particular, these species' biology tests the main protective provisions of the ESA, touching on critical habitat designation, consultation among federal agencies, and prohibitions against "take" of listed species. The uneasy fit of marine invertebrates into the Act's existing framework also provides new bases for challenging federal and federally-permitted actions in coastal environments.

The issue is particularly relevant for two reasons. First, one aspect of climate change, ocean acidification, is accelerating and promises to be especially harmful to these species.³ The result will be a dramatic increase in the number of imperiled marine invertebrates, and likely a higher number of listed species from this group. Second, the National Marine Fisheries Service ("NMFS")⁴ has recently found that listing another eighty-two coral species may be warranted, guaranteeing consideration of full federal protections for these species. Taken together, these changes could substantially alter the ESA's implementation, with profound implications for coastal land use and government action.

Marine invertebrates are different in kind from the animals that the ESA drafters likely envisioned. Specifically, these species' larvae present the thorniest challenges. Because each adult animal may produce billions of nearly microscopic, translucent larvae that float for hundreds or thousands of kilometers, the meaning of the ESA's "occupied habitat," "jeopardy," and "take" provisions changes immediately when applied to them. To take an extreme (if implausible) example, strict enforcement

3. See, e.g., Richard A. Feely, *Evidence for Upwelling of Corrosive "Acidified" Water onto the Continental Shelf*, 320 SCI. 1490, 1492 (2008); Miyoko Sakashita, *Harnessing the Potential of the Clean Water Act to Address Ocean Acidification*, 36 ECOLOGY L. CURRENTS 239, 240 (2009).

4. NMFS, also known as NOAA Fisheries, is within the National Oceanographic and Atmospheric Administration of the U.S. Department of Commerce. NMFS is the agency with jurisdiction over protected marine species, and shares responsibility for implementing the Endangered Species Act with the U.S. Fish and Wildlife Service (FWS), located within the Department of the Interior. The two agencies divide ESA jurisdiction based upon species habitats: NMFS administers the Act in connection with marine and anadromous species, FWS in connection with freshwater and terrestrial species. Consequently, I will focus the present discussion on NMFS, but much of the same information could apply to FWS in the context of aquatic animal species with widespread larvae. In addition, much of this paper is relevant to protected plant species, which are similar to marine invertebrates in many respects: wind-dispersed plants' pollen is for most purposes analogous to the marine larvae I discuss here, and existing seed banks raise similar questions with respect to occupied habitat. I do not focus on plants here for simplicity, because the Section 9 take provisions apply differently to plants and animals.

could subject a person to civil and criminal penalties for unwittingly killing a handful of nearly invisible larvae during a day at the beach.

This is the central paradox of the ESA's treatment of marine invertebrates: the Act plainly covers the species' larvae, and provides no *de minimis* exception. On the other hand, enforcing the ESA's provisions strictly would paralyze much federal activity in the ocean, and would make large-scale users such as water-cooled power plants guilty of serious violations. Such strict enforcement, especially if directed at more casual ocean users, could undermine popular support for the ESA and mobilize political will against the Act. At present, the ESA only protects four species of marine invertebrates: two corals and two abalones. However, as a rapidly-increasing number of species becomes imperiled, managing these and other species with similar life-histories will require reinterpreting these key provisions of the ESA.

Along with this paradox comes promise. As long as intact habitat exists, most species of marine invertebrates have great potential for recovery due to their high reproductive rates. Under the ESA's own terms, success entails the recovery of listed species to the point at which they no longer require the law's protection.⁵ In the case of the listed and candidate species of marine invertebrates, reasonable enforcement of existing protections for the weak links in the species' life cycles (e.g., the larval stages) might go a long way towards recovery, and could help the ESA earn some much-needed success stories.

In this paper, I discuss the implications of protecting marine invertebrates under the ESA, focusing in turn on four of the Act's main provisions. Rather than advocating for changes to the Act, I suggest solutions based in existing law for many of the challenges that these species present. The second section establishes the ESA's existing coverage of larval and juvenile stages of all listed species. The third, fourth, and fifth sections discuss the Act's no-take, federal consultation, and critical habitat provisions, respectively, in the context of the biology of marine invertebrate species. The sixth section concludes with a brief discussion of the political implications of listing more marine invertebrates, with lessons drawn from analogous fish species.

A. About Invertebrates and Larvae, Briefly

Congress passed the ESA with overwhelming and bipartisan majorities, aided in no small part by the rhetoric surrounding the protection of charismatic species such as the bald eagle, the grizzly bear,

5. 16 U.S.C. §§ 1531-1532.

and the wolf.⁶ While such species are undoubtedly iconic and ecologically critical, large vertebrates⁷ are more useful as rallying points than they are representative of biological diversity; vertebrates comprise about one percent of all named species.⁸ Those species without backbones, known collectively as invertebrates, make up the other ninety-nine percent. In contrast to vertebrates, invertebrates tend to have complex life cycles, entailing multiple larval stages.

Although larvae may seem to be negligible parts of a protected species' life cycle, they are in fact critical to its survival and dispersal.⁹ The tiny larval and juvenile stages of marine invertebrates are developmentally hard-wired, as obligatory during development as human infants are to adults. Moreover, because marine invertebrates are generally sedentary (or nearly so) as adults,¹⁰ the tiny water-borne larval stages are most species' only means of dispersing from one location to another. Dispersal creates genetic linkages among populations and avoids the pitfalls of severe inbreeding.¹¹ Settlement and recruitment¹²

6. See Shannon Petersen, *Congress and Charismatic Megafauna: A Legislative History of the Endangered Species Act*, 29 ENVTL. L. 463, 479 (1999).

7. *I.e.*, species with backbones, such as the abovementioned eagle, bear, and wolf.

8. Surprisingly, the total number of described species is not known. Less surprisingly, the total number of species both named and unnamed is a larger question, and is more uncertain. Regardless of the precise numbers, vertebrates make up a very small portion of the earth's biodiversity. See Terry L. Erwin, *How Many Species are There?: Revisited*, 5 CONSERVATION BIOLOGY 330 (1991); Robert M. May, *How Many Species are There on Earth?*, 241 SCI. 1441 (1988); Nigel E. Stork, *How Many Species are There?*, 2 BIODIVERSITY AND CONSERVATION 215 (1993).

9. Marine invertebrate larvae fall into two general categories: those that feed before metamorphosis into adults, and those that do not. Feeding larvae tend to be long-lived, persisting in the ocean for months as they pass through a series of developmental stages before becoming more recognizable adult forms. By contrast, nonfeeding larvae must survive on the remaining yolk from the maternal egg, and therefore must metamorphose into a feeding stage within a week or so, though the timing and different developmental stages vary widely between species. Because parental resources are limited, the overall amount of matter and energy the parents use to produce offspring is capped, creating a tradeoff: a species can either make many poorly-provisioned larvae or fewer better-provisioned ones. As one might expect, the poorly-provisioned feeding larvae have a proportionately slimmer chance of survival. This is one example of a larger phenomenon of reproductive tradeoffs, known to biologists as "r-selection" versus "K-selection." Species that are r-selected tend to be small-bodied with many offspring, little parental investment, and fast population growth rates not limited by outside resources (e.g., mosquitoes). K-selected species, by contrast, tend to be large-bodied, produce few offspring, have more parental involvement, and be resource-limited (e.g., elephants). Marine invertebrates nearly all fall on the r-selection side of the spectrum relative to other animals, but those with nonfeeding larvae produce fewer, better-provisioned offspring and thus are more K-selected than species with feeding larvae.

10. See Robert R. Warner, *Evolutionary Ecology: How to Reconcile Pelagic Dispersal with Local Adaptation*, 16 CORAL REEFS S115, S115 (1997).

11. See, e.g., Robin S. Waples, *Separating the Wheat from the Chaff: Patterns of Genetic Differentiation in High Gene Flow Species*, 89 J. HEREDITY 438, 448 (1998).

of these larvae can be the limiting factor in a species' distribution and abundance, a phenomenon known in the scientific literature as "supply-side ecology."¹³ As a result, failing to include protections for imperiled species' larvae and juveniles could vitiate protections for the species altogether.

Because these species' biology differs fundamentally from that of the charismatic vertebrates named above, it should be no surprise that marine invertebrates will push the boundaries of the ESA's provisions.

B. *About the ESA, Briefly*

Perhaps the best-known and most politically charged aspect of the ESA is Section 9's strict prohibition on "take" of endangered species.¹⁴ Under Section 9, to "take" means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct."¹⁵ The provision is construed "in the broadest possible manner to include every conceivable way in which a person can 'take' or attempt to 'take' any fish or wildlife,"¹⁶ though the Supreme Court has limited violations to include only actions that cause actual harm to listed species.¹⁷ Importantly, even habitat destruction may be "take" of a listed species provided that it causes actual harm.¹⁸ The ESA's Section 9 take provisions apply to all actors, public and private.

12. In larval ecology, *settlement* generally refers to larval metamorphosis and physical transition to a bottom-dwelling form, while *recruitment* refers to successful survival once settled.

13. The importance of larvae as a limiting factor has been an area of active scientific debate for the better part of three decades, but most marine ecologists would agree that in at least some species and some circumstances, abundance and distribution are limited by larval supply, settlement, or recruitment. This is particularly likely in imperiled species—which are rare almost by definition—and which are therefore likely to have low larval supply. See, e.g., Terry P. Hughes, *Supply-Side Ecology Works Both Ways: The Link Between Benthic Adults, Fecundity, And Larval Recruits*, 81 *ECOLOGY* 2241, 2241 (2000) (finding that small changes in coral fecundity can have disproportionately large effects in recruitment—a case of larval supply strongly influencing the next generation's abundance and potential distribution).

14. 16 U.S.C. § 1538 (2006).

15. *Id.* § 1532(19).

16. *Babbitt v. Sweet Home Chapter of Cmty. for a Great Or.*, 515 U.S. 687, 704 (1995); *Strahan v. Cox*, 127 F.3d 155, 162 (1st Cir. 1997) (both cases quoting S. REP. NO. 93-307, at 7 (1973), *reprinted in* 1973 U.S.C.C.A.N. 2989, 2995 (1973)).

17. *Sweet Home*, 515 U.S. at 700.

18. *Id.*; *Sierra Club v. Lyng*, 694 F. Supp. 1260, 1271 (E.D. Tex. 1988) (finding that the U.S. Forest Service's management techniques for forest habitat of Red Cockaded Woodpecker created actual harm to the species and were thus "take" under Section 9), *aff'd in part, vacated in part sub nom.* *Sierra Club v. Yeutter*, 926 F.2d 429 (5th Cir. 1991).

Section 7¹⁹ of the Act sets out a mechanism by which federal agencies must carry out the Act's principal aims. This section therefore applies only to the discretionary actions of federal agencies,²⁰ and not to private landowners.²¹ Under Section 7, each federal agency must consult with NMFS or FWS to ensure that any agency action "is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [designated critical] habitat of such species."²² The federal actions that trigger Section 7 consultation are broad and include virtually any kind of federal activity.²³ The consultation itself is a two-step process, each step of which results in a document containing formal findings.

The first consultation step requires an applicant agency to prepare a Biological Assessment for review by NMFS or FWS if its proposed action is a major project likely to adversely impact listed species or critical habitat.²⁴ If the Biological Assessment indicates that the action would not ultimately have such impacts, the consultation is over and the project may proceed.²⁵

If the action would adversely impact listed species or critical habitat, the second step then requires either formal²⁶ or informal²⁷ consultation as to how to avoid those impacts. Informal consultation allows the applicant agency to mollify the Biological Assessment's identified impacts by reaching an agreement with NMFS or FWS to modify the original proposed action.²⁸ By contrast, formal consultation results in a Biological Opinion (BiOp) by NMFS or FWS and a finding of "jeopardy" or "no jeopardy" (i.e., that the proposed action either would or would not be likely to jeopardize the continued existence of any listed species or designated critical habitat).²⁹ A "jeopardy" BiOp will contain "reasonable and prudent alternatives" to the proposed project

19. 16 U.S.C. § 1536 (2006).

20. *Nat'l Ass'n of Home Builders v. Defenders of Wildlife*, 551 U.S. 644, 667 (2007) (holding agency's mandate to "insure" federal actions do not destroy or adversely modify designated critical habitat was restricted to discretionary agency actions).

21. Though the Section 9 "take" provisions, which do apply to private landowners, perhaps offer stronger protections than Section 7 would.

22. 16 U.S.C. § 1536(a)(2).

23. 50 C.F.R. § 402.02 (2010) (referring to the National Environmental Policy Act, 42 U.S.C. § 4332(2)(C) (2006)).

24. *Id.* § 402.12(a).

25. Note, however, that the listing agency can require mitigation measures even if the proposed federal action would not cause jeopardy or adverse modification. 16 U.S.C. § 1536(b)(3) (2006).

26. 50 C.F.R. § 402.14.

27. *Id.* § 402.13.

28. *Id.*

29. *Id.* § 402.14.

that, if implemented, would avoid seriously affecting the listed species or critical habitat. A “no jeopardy” BiOp, or the implementation of the identified reasonable and prudent alternatives, will automatically trigger an Incidental Take Statement (ITS), exempting the holder from liability for ESA Section 9 take of listed species and allowing the proposed federal action to proceed.³⁰ Even if no jeopardy is found, the agency can still require “reasonable and prudent measures to minimize the impacts.”³¹

A further Section 7 procedure bears mentioning. Programmatic consultation³² is attractive in the case of serially repeated agency actions that are similar enough to warrant a single, wholesale consultation process covering all of the proposed actions. An agency proposing such serial actions might ask for a broad review of its planned activities, in order to secure a broad ITS. Programmatic consultation likely glosses over details of particular actions that would receive closer scrutiny under an action-by-action consultation, but might better account for the cumulative impacts of many incremental actions.

Section 4 of the ESA governs listing species as endangered or threatened, and also requires that the responsible agency designate critical habitat for the species, “to the maximum extent prudent and determinable.”³³ This provision requires the agency to designate habitat,

30. The Incidental Take Statement must provide a maximum number of individuals to be taken, or if using a surrogate measure rather than an actual number, must explain why the numerical measure of take is impracticable. *See Or. Natural Res. Council v. Allen*, 476 F.3d 1031, 1037 (9th Cir. 2007) (holding invalid FWS’ Incidental Take Statement for failure to establish that it could not set a numerical measure of ‘take’ of the northern spotted owl). Note also that, when the bearer is a federal entity, this document is referred to as an “Incidental Take Statement”; when non-federal, as an “Incidental Take Permit.” These permits are otherwise equivalent.

31. *Natural Res. Def. Council v. Evans*, 279 F. Supp. 2d 1129, 1176 (N.D. Cal. 2003) (citing *Thomas v. Peterson*, 753 F.2d 754, 763 (9th Cir. 1985)). Note also that a non-federal applicant for a federal permit, such as a wetland fill permit, can request the permitting agency consult with the ESA-implementing agency if he “has reason to believe that an endangered species or a threatened species may be present in the area affected by his project and that implementation of such action will likely affect such species.” 16 U.S.C. § 1536(a)(3) (2006). Presumably, the motive to do so would be to secure an Incidental Take Permit, shielding the applicant from further ESA requirements or liabilities.

32. Programmatic consultation is not explicitly defined or introduced in the regulations governing interagency consultation, but rather is a standard Section 7 process applied with a larger scope. *See, e.g., MEMORANDUM OF AGREEMENT, ENDANGERED SPECIES ACT SECTION 7 PROGRAMMATIC CONSULTATIONS AND COORDINATION AMONG BUREAU OF LAND MANAGEMENT, FOREST SERVICES, NATIONAL MARINE FISHERIES SERVICE, AND FISH & WILDLIFE SERVICE* (Aug. 30, 2000), http://www.fs.fed.us/biology/resources/pubs/tes/MOA-final_000830.rtf/ [hereinafter FOREST SERVICE MOA].

33. 16 U.S.C. § 1533(a)(3)(A), (b)(6)(C)(ii).

unless doing so would not be prudent,³⁴ and the agency must publish its reasoning if it does not designate habitat.³⁵ In practice, however, the agencies often fail to designate critical habitat unless forced to by a court order.³⁶

Critical habitat should comprise at least some geographic areas that the species occupies at the time it is listed, in which physical or biological features are found that are both essential for the species' conservation and that may require special protection.³⁷ Unoccupied habitat may also be deemed critical if it is essential for the species' conservation.³⁸ The agency need not designate all occupied habitat as critical and may, for example, exclude habitat where sufficient safeguards for the imperiled species are already in place.³⁹ As a result, some fraction of habitat that a listed species already occupies is often not designated as part of the species' critical habitat.⁴⁰ Importantly, NMFS or FWS may consider the economic effects as well as the conservation benefit of designating critical habitat, in contrast to the listing decision, which allows no such balancing.⁴¹

A final ESA provision that has become increasingly important over the past two decades is Section 10,⁴² which creates a mechanism for compromise to mitigate the no-take language of Section 9. This provision grants agencies the authority to issue Incidental Take Permits (ITP) and Statements to allow take of a listed species for otherwise

34. 50 C.F.R. § 424.12(a) (2010) (specifying that designating habitat is not prudent when doing so would increase the threat to the species, and/or when the designation would not benefit the species).

35. *Id.*; see *Natural Res. Def. Council v. U.S. Dep't of the Interior*, 113 F.3d 1121, 1127 (9th Cir. 1997) (finding FWS had no rational basis for declining to designate critical habitat).

36. See, e.g., *Ctr. for Biological Diversity v. Evans*, 2005 WL 1514102, at *7 (N.D. Cal. 2005) (instructing NMFS to designate habitat for the Northern Right Whale). FWS reports a total of 595 species have designated critical habitat, out of a total of 1411 listed species in the United States. See U.S. Fish & Wildlife Service, *General Statistics for Endangered Species*, http://ecos.fws.gov/tess_public/TessStatReport (last visited December 3, 2010).

37. 50 C.F.R. § 424.02(d).

38. *Id.*

39. See, e.g., *Designation of Critical Habitat for Three Threatened Mussels and Eight Endangered Mussels in the Mobile River Basin*, 69 Fed. Reg. 40,084, 40,096 (Jul. 1, 2004) (codified at 50 C.F.R. §17.95) (FWS's designation of critical habitat for some freshwater mussels).

40. See, e.g., *12-Month Determination on How to Proceed with a Petition to Revise Designated Critical Habitat for Elkhorn and Staghorn Corals*, 75 Fed. Reg. 3,711, 3,711 (Jan. 22, 2010) (determining that redefining critical habitat for listed corals to encompass some known populations was precluded).

41. *New Mexico Cattle Growers Ass'n v. U.S. Fish & Wildlife Serv.*, 248 F.3d 1277, 1285 (10th Cir. 2001); 50 C.F.R. § 402.12.

42. 16 U.S.C. § 1539(a) (2006).

lawful activities by nonfederal actors, under an approved plan that would not disadvantage the species.⁴³ These Habitat Conservation Plans (HCPs) essentially sidestep Section 9's absolute terms and allow custom conservation deals, described only in broad terms in Section 10 of the ESA.⁴⁴

Part II will establish that the ESA protects listed species during all phases of their life cycles, including the tiny larval stages that are critical to species' survival and recovery, before the subsequent parts address the implications of listing marine invertebrates for the ESA's individual Sections.

II. THE ESA PROTECTS SPECIES' LARVAE AND NOT JUST ADULTS

There is no question that the Act covers even the very small larval stages of listed species. Three lines of evidence make this clear: (1) the text of the Act itself and its associated regulations, (2) past agency practice, and (3) the limited case law on analogous questions in vertebrate species.

The language of the ESA is remarkably broad in its coverage of listed species, and explicitly protects the species' different life stages, parts and products. The Definitions Section provides:

The term "species" *includes any subspecies of fish or wildlife or plants . . . which interbreeds when mature.*⁴⁵

The term "fish or wildlife" means any member of the animal kingdom, including *without limitation* any mammal, fish, bird . . . amphibian, reptile, *mollusk, crustacean, arthropod or other invertebrate*, and includes *any part, product, egg, or offspring thereof*, or the dead body or parts thereof.⁴⁶

Read together, these definitions cover *any part or product of any listed species*, even singling out some invertebrate groups by name. The federal rules governing the ESA's interpretation mirror the Act's broad definitional language,⁴⁷ and the legislative history emphasizes the ESA's

43. *Id.* § 1539(d)(2). The plan must also be consistent with the purposes of the ESA. *Id.* § 1539(d)(3).

44. Plans must disclose their anticipated impact on the species, ensure they maximally mitigate that impact and have sufficient funds to do so, provide and consider alternatives to the stated plan, and not place the species in jeopardy. *Id.* § 1539(a)(2).

45. *Id.* § 1532(16) (emphasis added). Note also that the inclusion of the phrase "when mature" suggests that immature individuals are similarly encompassed by the term "species." Presumably, membership in a "species" for the purposes of the ESA does not vary over the course of an individual's lifetime.

46. *Id.* § 1532 (8) (emphasis added).

47. *See* 50 C.F.R. § 424.02(n) (2010).

inclusive aim, with the final Senate report highlighting the “broad” definition of covered organisms.⁴⁸ The larval stages of listed invertebrates thus fall squarely within the Act’s ambit: a protected species is protected at all stages of its life cycle.⁴⁹

Federal administrative agency practice is also consistent with ESA protection for the larvae, gametes, and juveniles of listed species. This issue primarily arises in the context of threatened and endangered salmonid⁵⁰ fishes. Because they live in aquatic environments and produce hundreds of thousands of larvae each year, a small number of which survive to adulthood, these fishes are fairly precise analogs for listed invertebrate species. NOAA has levied substantial civil penalties under the ESA against violators for take of endangered fry⁵¹ or juvenile fishes,⁵² for example, and other agencies have explicitly considered protections for fry in their decisions.⁵³ The text of the Act gives no reason to suspect that listed invertebrates merit less protection than vertebrates in this respect.⁵⁴

48. See S. REP. NO. 93-307, at 7 (1973), *reprinted in* 1973 U.S.C.C.A.N. 2989, 2995 (1973).

49. Note that there is a logical requirement, too, that the Act cover all life stages. A species’ survival (to say nothing of recovery) is dependent on its individuals completing development and reproducing. It would undermine the purposes of the ESA, and would be incredibly wasteful, to protect the adults of a species and not the larvae. The vertebrate equivalent would be ensuring the grizzly bears’ persistence by banning the hunting of adults while allowing open season on the cubs.

50. Salmon species and their close relatives.

51. Salmonids first hatch from eggs into a larval stage, during which time they are known as “fry.” They subsequently become juveniles, before reaching maturity after spending months to years in their natal stream. See, e.g., Nat’l Oceanic & Atmospheric Admin., *Chinook Salmon*, <http://www.nmfs.noaa.gov/pr/species/fish/chinooksalmon.htm> (last visited December 3, 2010). I refer to fry and larvae interchangeably.

52. *In re Anderson-Cottonwood Irrigation Dist.*, 6 O.R.W. 851, 854 (NOAA 1992) (levying \$700,000 fine against small irrigation district for entraining endangered Chinook salmon fry). The parallel state case cited California Department of Fish & Game estimates that fewer than 2.5percent of the salmon run’s fry had been entrained. See *Dep’t of Fish & Game v. Anderson-Cottonwood Irrigation Dist.*, 8 Cal. App. 4th 1554, 1560 (Cal. Ct. App. 1992).

53. See *generally* Pub. Util. Dist. Chelan Cnty., Wash., 98 F.E.R.C. P61,279 (2002) (Federal Energy Regulatory Commission approving and licensing hydropower plan which included protections for endangered salmon and steelhead fry); *City of Seattle*, 71 F.E.R.C. P61,159 (1995) (similar).

54. While the Distinct Population Segments (DPS) provision of the ESA’s Section 4 only applies to vertebrates, 16 U.S.C. § 1532 (2006), Section 4’s definitions don’t discriminate between invertebrate and vertebrate animals. Further, Congress amended the law in 1978 to favor vertebrates in the DPS definition, and the other Sections were not changed. See *Endangered Species Act Amendments of 1978*, Pub. L. No. 95-632 (1978); H.R. REP. NO. 95-1804, at 17 (1978) (Conf. Rep.), *reprinted in* 1978 U.S.C.C.A.N. 9484, 9485 (1978).

Endangered species status reviews, mandated under the ESA,⁵⁵ also attest to agency treatment of juveniles and larvae as covered by the law. NMFS's status review of the white abalone in 2000, for example, discussed potential effects of climate change on the species' larval stages,⁵⁶ and salmonid fry are mentioned throughout the nearly 600-page omnibus 2005 status review of west coast salmon and steelhead.⁵⁷ Additionally, agency BiOps, required under the ESA's Section 7 consultation provision for federal agency actions that may impact listed species, also routinely mention larvae and juveniles of listed species.⁵⁸

The relevant case law further substantiates the ESA's protections for larvae and juveniles. Most obviously, entraining and harming the fry of listed salmonid species amounts to "take."⁵⁹ More subtly and most often, courts generally treat salmonid fry and adults as equally protected without distinguishing between the two.⁶⁰ Importantly, this treatment is consistent regardless of whether the court's decision tends to strengthen or weaken as-applied protections in any given case. In the few cases dealing with the larvae of non-salmonid species, courts have not

55. 16 U.S.C. §1533(c).

56. See Alistair J. Hobday & Mia J. Tegner, NOAA Technical Memoranda NMFS-SWR-035: Status Review of White Abalone (*Haliotis sorenseni*) Throughout its Range in California and Mexico, at 35 (May 2000), <http://www.nmfs.noaa.gov/pr/pdfs/statusreviews/whiteabalone.pdf>.

57. See generally NOAA Technical Memoranda NMFS-NWFSC-66: Updated Status of the Listed ESUs of West Coast Salmon and Steelhead (Thomas P. Good, Robin S. Waples, & Pete Adams, eds., June 2005), <http://www.nwr.noaa.gov/Publications/Biological-Status-Reviews/upload/SR2005-allspecies.pdf>.

58. For a discussion of one such example, see Holly Doremus & A. Dan Tarlock, *Fish, Farms, and the Clash of Cultures in the Klamath Basin*, 30 *ECOLOGY L.Q.* 279, 328-29 (2003) ("In its BiOp, FWS . . . concluded that the proposed project operations would jeopardize the key Upper Klamath Lake populations of both sucker species for several reasons. First, screening of A Canal would **reduce entrainment of juveniles but not larvae**, and entrainment would continue at Link River Dam. . . . The agency went to great pains to explain how water depth could affect dissolved oxygen, pH, nutrient availability and algal blooms, and set out evidence supporting those connections. It also detailed the precise relationship between changes in lake depth and availability of habitats suitable for **spawning, larvae, juvenile, and adult fish.**") (emphases mine); see also Kristin Carden, *Bridging the Divide: The Role of Science in Species Conservation Law*, 30 *HARV. ENVTL. L. REV.* 165, 254 (2006).

59. *United States v. Glenn-Colusa Irrigation Dist.*, 788 F. Supp. 1126, 1131 (E.D. Cal. 1992).

60. See, e.g., *Natural Res. Def. Council v. Kempthorne*, 2007 WL 4462395, at *1 (E.D. Cal. Dec. 14, 2007) (discussing Delta smelt larvae and juveniles as protected); *Forest Conservation Council v. Espy*, 835 F. Supp. 1202, 1217 (D. Idaho 1993), *aff'd*, 42 F.3d 1399 (9th Cir. 1994) (finding NMFS's treatment of salmon eggs and fry, among other issues, satisfied ESA consultation requirements); *Pac. Coast Fed'n of Fishermen's Ass'ns v. Gutierrez*, 606 F. Supp. 2d 1122, 1174 (E.D. Cal. 2008) (reviewing NMFS's Biological Opinion concerning loss of salmon eggs and fry).

addressed the question directly, but rather proceeded on the assumption that the ESA covers the larvae as well as the adults.⁶¹

Thus the broad statutory language, past agency practice, and the little relevant case law all indicate that the ESA's protections encompass the larval and juvenile stages of listed species. Threatened and endangered marine invertebrates therefore create a double-bind for NMFS, which has neither the discretion to weaken the existing species' protections, nor the political support to strictly enforce them. Once a species is listed as endangered or threatened, agency discretion would seem to near its end: because the ESA has no *de minimis* exception, doing harm to a species' larvae is a violation of Section 9's "take" provisions, and federal action that adversely modifies critical habitat violates Section 7's consultation requirements. Nevertheless, the agency makes important decisions in designating a species' critical habitat that profoundly affect nearby federal activities via the Act's Section 7 consultation provision.

Below, I discuss why the biology of marine invertebrates changes the interpretation and application of ESA Sections 9 and 7, and then subsequently address the implications of listing these species for the ESA's Section 4 requirement to designate species' critical habitat. Each statutory Section provides the agencies with an opportunity—and a requirement—to safeguard the listed species and the ecosystems of which they are a part. Conversely, applying the ESA to species quite different from the photogenic vertebrates that served as models for the Act creates opportunities for coastal stakeholders to challenge a wide variety of government actions—such as land-use decisions and pollution permits—that could adversely impact the listed species and their nearshore ecosystems.

III. HOW CAN WE SENSIBLY APPLY THE ESA'S SECTION 9 "TAKE" PROHIBITION TO IMMATURE FORMS OF LISTED SPECIES?

Although it functions relatively well when applied to vertebrates and other readily identifiable species, Section 9 creates the paradox introduced above when applied to marine invertebrates. The larval stages of listed invertebrates can be pervasive over much of the heavily-used coastlines where the adults occur, and even seemingly harmless activities, such as swimming or fishing at the beach, could conceivably

61. See generally *Pac. Shores Subdivision Cal. Water Dist. v. U.S. Army Corps of Eng'rs*, 538 F. Supp. 2d 242 (D.D.C. 2008) (Oregon Silverspot Butterfly); *Ctr. for Biological Diversity v. U.S. Fish & Wildlife Serv.*, 2005 WL 2000928 (N.D. Cal. Aug. 19, 2005) (Tiger Salamander); *Middle Rio Grande Conservancy Dist. v. Babbitt*, 206 F. Supp. 2d 1156, 1187 (D.N.M. 2000), *aff'd sub nom. Middle Rio Grande Conservancy Dist. v. Norton*, 294 F.3d 1220 (10th Cir. 2002) (Spikedace and Loach Minnow).

take a small number of a listed species' larvae in a gulp of seawater or a few drops onto dry land. Because the ESA contains no *de minimis* exception to Section 9, these everyday activities could at least theoretically result in liability for unsuspecting (and blameless) citizens.⁶² Thus while enforcing the ESA's Section 9 provisions is nominally mandatory for the agencies and perhaps required for the species' survival, strict enforcement would interrupt a wide variety of economic and social activities along the nation's coastlines. Consequently, strict enforcement would likely undermine popular support for the Act.

Clearly there are enormous problems with taking the Section 9 prohibitions to such extremes. Doing so would fail the laugh test, for one, as it did in *United States v. Wang Lin Co.*,⁶³ which ended in a settlement and dropped criminal charges for a farmer accused of violating Section 9 by preparing his fields for planting, to the detriment of the endangered Tipon Kangaroo Rat and other species.⁶⁴ In that case, the specter of a jury trial—in the face of media attention and derision from Capitol Hill—over take of the endangered rat proved an insurmountable barrier to criminal prosecution for ESA violations.⁶⁵

The evidentiary challenges for ESA enforcement of casual or unknowing take of marine invertebrate larvae are perhaps even more formidable. For example, how would the agency attempt to prove that a swimmer had ingested an abalone larva, killing it and triggering a Section 9 take? But as a thought experiment, the day-at-the-beach example is useful as an end point of an enforcement continuum that highlights the biological differences between marine invertebrates and the terrestrial megafauna for which the ESA was largely written, and the challenges those differences create.

A more likely real-world enforcement scenario is an ongoing violation that kills many larvae. A primary example is a water-cooled power plant on the coast that results in high mortality for a listed species' larvae, especially where the larvae are a limiting life stage for that species. Such a case would be a far cry from criminal prosecution for incidental take of seawater-borne abalone larvae, but would nevertheless

62. Knowing violations of the ESA trigger the most serious penalties—up to \$25,000 in civil fines for each violation, and \$50,000 in criminal fines, as well as up to a year in prison. Unknowing violations are subject to civil fines of \$500 per violation, still potentially ruinous when it is so easy to harm a large number of larvae, committing many violations simultaneously. See 16 U.S.C. § 1540(a)-(b) (2006).

63. See *United States v. Wang Lin Co.*, No. 94-5041 (E.D. Cal. 1994).

64. See Kimberly L. Mayhew, *United States v. Wang Lin Company: The Kangaroo Rat and Criminal Prosecution Under the Endangered Species Act*, 6 SAN JOAQUIN AGRIC. L. REV. 193, 217 (1996).

65. *Id.* at 217-21.

represent a significant political hurdle, pitting an important piece of energy infrastructure against nearly invisible larvae. While it is not known how many invertebrate larvae such ocean-water-cooled plants entrain altogether, analogous freshwater plants kill billions of larvae each year,⁶⁶ and coastal power plants are very likely to cause similarly significant mortality to marine larvae.

Like *Tennessee Valley Authority v. Hill*,⁶⁷ in which a tiny fish no one had ever heard of stood in the way of a hugely expensive and nearly-completed dam, the marine invertebrate dilemma puts the ESA's aspirational terms to a difficult test. Must we protect every one of the millions of listed species' microscopic larvae in the ocean? Should we protect them? If so, to what extent should we protect them? Below, I suggest ways to alleviate the invertebrate dilemma within the bounds of the current ESA.⁶⁸

A. There is no De Minimis Exception to Section 9 "Take"

The ESA's text, interpretive regulations, case law, and statutory purpose all indicate that no *de minimis* exception exists to Section 9's prohibition on take of listed species. Beyond the Act's broad proscription of take of any endangered species,⁶⁹ extended to threatened species by regulation,⁷⁰ a robust line of case law has strictly enforced Section 9's provisions. *Tennessee Valley Authority v. Hill* remains perhaps the best example, but more recent cases are in accord.⁷¹ Further,

66. See Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities, 69 Fed. Reg. 41,576, 41,586 (July 9, 2004) (codified at 30 C.F.R. pt. 9, 122, 123, 124, 125) (estimating 3.4 billion annual mortality events for fish and shellfish larvae and juveniles).

67. 437 U.S. 153 (1978).

68. Note that freshwater mussels, which would appear to be closely analogous to corals for purposes of Section 9, generally do not have free-living larval stages, and therefore avoid many of the issues that attend take in the case of marine invertebrates. See Proposed Endangered Status for the Georgia Pigtoe Mussel, Interrupted Rocksnail, and Rough Hornsnail with Critical Habitat, 74 Fed. Reg. 31,114, 31,115 (June 29, 2009) (codified at 50 C.F.R. pt. 17). The larval stage of the Unionidae, a large family of freshwater mussels, is known as a "glochidium" and is parasitic on the gills of some fishes as well as on some other vertebrates such as amphibians. See GERHARD BAUER AND KLAUS WÄCHTLER, ECOLOGY AND EVOLUTION OF THE FRESHWATER MUSSELS UNIONOIDA 4 (2001).

69. 16 U.S.C. § 1538(a)(1) (2006).

70. *Id.* § 1533(d).

71. See, e.g., *United States v. McKittrick*, 142 F.3d 1170 (9th Cir. 1998) (upholding conviction and criminal penalties for Section 9 violation against defendant who shot a single listed wolf, despite the defendant's lack of knowledge of what he was shooting); *United States v. Zak*, 486 F. Supp. 2d 208 (D. Mass. 2007) (The court affirmed the defendant's conviction for killing a single juvenile bald eagle, under the analogous Bald and Golden Eagle Protection Act. The species was also listed under the ESA at the time.). A related line of cases upholding the constitutionality of the ESA under the

the cumulative impact of *de minimis* takings could be fatal to a listed species. Preventing the survival and recovery of such species would defeat the entire purpose of the ESA. In sum, Section 9 plainly prohibits take of even larvae, though prosecution for such a violation does not necessarily follow. If the ESA is to function well in shepherding listed marine invertebrates through survival and recovery, the agencies will have to make reasoned prosecutorial decisions that will maximize benefits for listed species while minimizing the drain on already-stressed agency resources.

Strict enforcement by NMFS⁷² would probably test the outer bounds of public support for the ESA. Nevertheless, environmental groups will likely use ESA citizen-suits to enjoin coastal development and other ongoing activities that might cause substantial take of listed species' larvae, such as commercial fishing. Industry groups are just as likely to use the specter of criminal penalties for take of microscopic larvae to their political advantage. NMFS, caught between these advocacy groups and having a mandate to aid in the recovery of listed species, can thread this needle through a combination of prosecutorial discretion, tailored regulations and short-term Habitat Conservation Plans (HCPs) that encourage active efforts to increase listed species' chances of recovery and minimize take under Section 9.

B. *Prosecutorial Discretion*

Prosecutorial discretion is the obvious way to avoid punishing *de minimis* harms. Although the Act seems to grant NMFS and FWS little leeway to avoid applying the take prohibition (e.g., the enforcement Section of the ESA states that the agencies *shall* enforce the penalties

Commerce Clause also support the inference that the Act has no *de minimis* exception. *See Alabama-Tombigbee Rivers Coal. v. Kempthorne*, 477 F.3d 1250, 1272-73 (11th Cir. 2007) ("When 'a general regulatory statute bears a substantial relation to commerce, the *de minimis* character of individual instances arising under that statute is of no consequence.'" (quoting *United States v. Lopez*, 514 U.S. 549, 558 (1995))); *GDF Realty Inv., Ltd. v. Norton*, 326 F.3d 622 (5th Cir. 2003) (upholding ESA protection of subterranean invertebrate species despite limited impact on interstate commerce).

72. NMFS' enforcement of ESA violations apparently takes place through the Fish and Wildlife Service. FWS responded to FOIA requests for enforcement records, which I had sent to NOAA/NMFS. Enforcement has been lax, according to these records: the enforcement database contains a single case of ESA violations with respect to corals, which yielded no criminal or civil fines. A total of seven abalone violations appear to have generated a grand total of \$769 in fines, with two open investigations pending. Freedom of Information Act Request Response from U.S. Fish and Wildlife Service, Enforcement Record of Section 9 Violations for Coral, to author (May 27, 2010) (on file with author); Freedom of Information Act Request Response from U.S. Fish and Wildlife Service, Enforcement Record of Section 9 Violations for Abalone, to author (May 26, 2010) (on file with author).

provided),⁷³ in practice the agencies retain considerable control over whom and what to prosecute for environmental violations. One reason is simply that a degree of enforcement prioritization is inevitable given limited agency budgets. More importantly, courts have expressly upheld a level of agency discretion that allows the implementing agencies to retain decisionmaking power in enforcing the Act.

Heckler v. Chaney,⁷⁴ which enshrined administrative prosecutorial discretion as unreviewable under the Administrative Procedures Act,⁷⁵ also suggests that NMFS and FWS have the authority to decline to prosecute some ESA violations. And because the ESA's citizen suit provision only provides for injunctive relief rather than penalties,⁷⁶ citizen suits could only stop ongoing violations rather than redressing one-time breaches of Section 9. Especially because one-time violations for take of listed larvae are likely to be particularly prone to practical and evidentiary problems, as well as larger concerns about fairness and notice, they are therefore surefire candidates for a policy of non-prosecution. A guidance memo to this effect, though it would not have the force of law,⁷⁷ would likely assuage any public concern about indiscriminate prosecution for incidental violations.

It would also make sense to scale the severity of the penalty for a Section 9 take violation, and the likelihood of prosecution, by the gravity of the violation. In the case of penalties for the take of listed species' larvae, criminal and civil fines could quickly reach millions of dollars for even unknowing violations, because larvae are so small and numerous.⁷⁸ To some extent, the ESA provides for such scaling: the monetary penalties are assessed on a per-animal basis, automatically rising with the seriousness of the offense.⁷⁹ Under this system, knowing violations have far more serious penalties than unknowing ones.⁸⁰ But prosecutorial discretion, as noted above, is not built into the Act expressly.⁸¹

Given real-world constraints of time and resources, the agencies must prioritize their enforcement actions. Surely the highest-priority offenders are those with ongoing, large violations. Because it is easy to

73. 16 U.S.C. § 1540(e)(1).

74. 470 U.S. 821 (1985).

75. *Id.* at 838.

76. *See* 16 U.S.C. § 1540(g).

77. *See* *Christensen v. Harris Cnty.*, 529 U.S. 576, 587 (2000) (listing precedential decisions that guidance memos and similar documents lack the force of law and are not entitled to *Chevron* deference).

78. *See* 16 U.S.C. § 1540(a)-(b); *see also infra* note 178.

79. 16 U.S.C. § 1540(a)-(b) (listing fines "for each violation").

80. *Id.*

81. *See* Brandon L. Pham, *The Federal Endangered Species Act: Is Judicial Review Available to Safeguard Against Agency Decisions Not to Enforce?*, 13 UCLA J. ENVTL. L. & POL'Y 329, 356-57 (1995).

demonstrate they were the proximate cause of harm to the species, such offenders are both subject to the largest fines and are the easiest to prosecute. Further discretion comes in assessing fines: the ESA consistently uses the permissive term “may” in conjunction with its penalties, rather than the mandatory word “shall,” indicating that the listed fines are a ceiling and subject to deviation at the agency’s discretion.⁸² Although selective enforcement is normatively undesirable and will not by itself aid in the survival and recovery of listed species, intelligent prosecutorial choices could provide a meaningful incentive for actors to avoid taking listed species during their most vulnerable life stages.

C. *Tailored Regulations*

Narrowly-tailored regulations to protect these larvae would similarly be a large step towards carrying out the ESA’s mandate of ensuring species’ survival and recovery. The following are specific examples of tailoring regulations to better fit the biology of listed species.

1. Because Corals are Listed as Threatened and Not Endangered, NMFS Could Use Section 4(d) to Regulate the Take of Their Larvae

The first example of tailoring regulations is the Section 4(d) rule,⁸³ which allows the agencies to make custom rules for the protection of threatened—but not endangered—species. Even though agencies generally treat the two categories of listed species as having the same protections, Section 4(d) potentially allows some flexibility in the take prohibitions as applied to threatened species, with the important caveat that the new rule must be “necessary and advisable to provide for” the species’ conservation.⁸⁴ This caveat clearly limits the agencies’

82. *Id.*

83. 16 U.S.C. §1533(d).

84. “Whenever any species is listed as a threatened species pursuant to subsection (c) of this section, the Secretary shall issue such regulations as he deems necessary and advisable to provide for the conservation of such species. The Secretary may by regulation prohibit with respect to any threatened species any act prohibited under Section 1538(a) . . . with respect to endangered species; except that with respect to the taking of resident species of fish or wildlife, such regulations shall apply in any State which has entered into a cooperative agreement pursuant to Section 1535(c) of this title only to the extent that such regulations have also been adopted by such State.” *Id.*

rulemaking authority,⁸⁵ and in several cases courts have disallowed regulations that purported to protect threatened species only indirectly, by minimizing human-animal conflicts.⁸⁶

Unlike the two listed species of abalone, which are endangered, the two listed coral species are classified as threatened. NMFS is therefore free to promulgate rules governing the taking of corals, under the 4(d) rule, as long as the new rules provide for the conservation of the listed coral species. In fact, NMFS has already issued such regulations, applying the full Section 9 take prohibition to the threatened species, effectively treating them as endangered.⁸⁷ These regulations have not yet been challenged,⁸⁸ but should enforcement⁸⁹ in the future trigger the dilemma outlined above, NMFS has the flexibility to allow some take of the listed coral species if it can give a legitimate conservation goal that allowing such take would accomplish. Requiring large-scale users to mitigate any take of coral larvae, for example, would serve conservation

85. *See, e.g.,* *Sierra Club v. Clark*, 755 F.2d 608 (8th Cir. 1985) (noting that Secretary's use of 4(d) rule to regulate take of threatened species must "provide for the conservation of threatened species").

86. *See* *Christy v. Hodel*, 857 F.2d 1324, 1336 (9th Cir. 1988) ("Congress expressly contemplated that 'in the extraordinary case where population pressures within a given ecosystem cannot be otherwise relieved,' conservation may require 'regulated taking.'" (citing 16 U.S.C. § 1532(3))); *Sierra Club v. Clark*, 755 F.2d 608, 612 (8th Cir. 1985) (emphasizing that agency's discretion in regulating threatened species is limited to actions for the conservation of the species); *Fund for Animals, Inc. v. Turner*, Civ. A. No. 91-2201(MB), 1991 WL 206232, at *3-7 (D.D.C. Sep. 27, 1991) (rejecting FWS' authorization of a small-scale grizzly bear hunt, which the agency had attempted to allow under the 4(d) rule because it would make the bears wary of humans, and therefore aid in their conservation in the long run by reducing bear-human conflicts); *see also* *Humane Soc'y of U.S. v. Kempthorne*, 481 F. Supp. 2d 53, 65 (D.D.C. 2006), *vacating as moot* 527 F.3d 181 (D.C. Cir. 2008) (disallowing lethal take of threatened wolves, using similar logic).

87. *Conservation of Threatened Elkhorn and Staghorn Corals*, 73 Fed. Reg. 64,264, 64,271 (Oct. 29, 2008) (codified at 50 C.F.R. pt. 223) (applying Section 9 take prohibitions with two narrow exceptions for scientific and restoration purposes).

88. There is no mention of a challenge in published legal opinions or in the Federal Register.

89. I have filed Freedom of Information Act requests for documents related to enforcement actions under the ESA for both corals and abalones (April 6, 2010 and March 30, 2010), and have not yet received a substantive response. This was after an informal request for information was denied (in the case of abalone, by email, March 30, 2010) or failed to generate a substantive response (in the case of corals, by phone and email, during March and April of 2010). As a background matter, in FY2007, the most recent year for which statistics are available, FWS prosecuted 6420 cases involving species listed under the ESA, which was over half of the Service's caseload. *See* U.S. FISH & WILDLIFE SERVICE, ANN. REP., at 33 (2007), <http://www.fws.gov/le/about/annual.htm>.

goals if the mitigation were at a high benefit-to-harm ratio.⁹⁰ The agency would have an incentive to promulgate highly protective 4(d) rules, given the case law specifying that relaxed protections must ultimately be for the survival and recovery of the species. Because many of the parties taking ongoing and large numbers of individuals are likely to be federally-permitted actors who would have ITPs under Section 7, 4(d) rules would function to protect threatened species from ongoing violations by nonfederal actors.

2. Tailored Regulations Governing Federal Activities in Areas Likely to Contain Larvae

Ideally, NMFS could create reasonable regulations to govern the industrial and recreational uses of listed species' habitats, avoiding take and encouraging species' recovery while minimizing economic and social disruption.⁹¹ The ESA requires the agency to use the best available scientific and commercial data in its rulemakings,⁹² and recent developments in modeling and assay techniques make it possible to more efficiently tailor regulations to accommodate human use while better protecting listed species. In particular, seasonal and spatially-precise limitations in use permits are a tenable way of achieving these goals.

Such time- and place-specific regulation is nothing new: FWS and NMFS already take similar measures for other listed species, such as implementing seasonal road closures to protect Sonoran Pronghorn,⁹³ seasonal gillnet restrictions on commercial fishing to protect migrating turtles,⁹⁴ and seasonal land closures to protect endangered bird species' nesting sites.⁹⁵ In a slightly different context, the EPA's Clean Water

90. Releasing, say, ten larvae that would not have otherwise existed to mitigate the take of a single larva might greatly help recovery efforts and satisfy the courts that the 4(d) rule is for the conservation of the species.

91. *See, e.g.*, *Natural Res. Def. Council v. Evans*, 279 F. Supp. 2d 1129, 1176 (N.D. Cal. 2003) (“[T]he permanent injunction should be carefully tailored to reduce the risk to marine mammals and endangered species by restricting the sonar’s use in areas that are particularly rich in marine life, while still allowing the Navy to use this technology for testing and training in a variety of oceanic conditions.”). *But see* *Winter v. Natural Res. Def. Council*, 555 U.S. 7, 11 (2008) (vacating a tailored injunction on similar Navy sonar technology that had been affirmed in the Ninth Circuit to protect Southern California marine mammals).

92. 16 U.S.C. § 1533(b)(1)(A) (2006).

93. *See* *Closure of Public Lands*, 68 Fed. Reg. 11,873, 11,873 (Mar. 12, 2003).

94. *See generally* *Restrictions on Fishing Activities*, 67 Fed. Reg. 71,895, 71,895 (Dec. 3, 2002) (codified at 50 C.F.R. pt. 222, 223).

95. *See, e.g.*, *Seasonal Restrictions on Public Access to Federal Lands on the North Spit of Coos Bay and the New River Area of Critical Environmental Concern*, 69 Fed. Reg. 19,220, 19,220 (Apr. 12, 2004) (closing Bureau of Land Management and Army Corps of Engineers-controlled land during snowy plover nesting season).

Act regulations contemplate seasonal power plant closures as appropriate means of minimizing fish mortality from larval entrainment during cooling-water intake.⁹⁶ Similarly, under ESA regulations, water diversion from California's Bay-Delta system decreases when listed Delta Smelt larvae are detected,⁹⁷ though these measures are insufficient to prevent high percentages of larvae from being entrained.⁹⁸

Biological differences between species demand different management approaches, which can be an onerous burden. Individually managing marine invertebrates with species-specific reproductive seasons and requirements may appear especially burdensome. However, relevant technological advances make individualized species-management an asset, allowing regulations limited in space and time, and minimizing the regulatory footprint. By way of example, whereas severely restricting federal actions in all of the black abalone habitat via Section 7 is politically impossible (the species' range spans much of the California coast), regulating activities in particular regions of that habitat during peak spawning times is likely to be much more palatable and just as effective at helping the species recover. This provides a powerful incentive for the agency to expend the required effort to tailor its regulations while fully protecting the species as required under the ESA.

To carry out such regulations, ideally NMFS would be able to predict precisely when and where each species' adults and larvae would be, and these predictions would be available far enough in advance to provide adequate notice of impending regulation to the public. Further, the agency could condition ITPs on these predictions, enforcing a duty to mitigate harm to the listed species. Accurately predicting the presence of marine invertebrate larvae would have been impossible historically, and the adult forecasts would have not been much more tractable. Species often spawn over the course of months, with larvae carried for potentially vast distances along variable, wind-driven ocean currents, and adults settling in seemingly chaotic patterns that change with each year. Even more vexing, larvae have been difficult to identify with sufficient specificity to distinguish the larva of an endangered species of abalone from that of a common species.

96. Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities, 69 Fed. Reg. 41,576, 41,605, 41,688 (July 9, 2004) (codified at 50 C.F.R. pt. 9, 122, 123, 124, 125) (discussing mortality of larvae, and suggesting seasonal shutdowns as potentially appropriate operational measures to mitigate that mortality).

97. U.S. FISH & WILDLIFE SERVICE, BIOLOGICAL OPINION ON THE COORDINATED OPERATIONS OF THE CENTRAL VALLEY PROJECT (CVP) AND STATE WATER PROJECT (SWP), at 357-368 (2008), http://www.fws.gov/sacramento/es/documents/SWP-CVP_OPs_BO_12-15_final_OCR.pdf [hereinafter DELTA SMELT BIOP].

98. See *id.* at 367 (figure B-6).

However, recent modeling efforts in the ecosystems that support the coral and abalone species have begun to distill probabilistic patterns of larval dispersal and recruitment in specific habitats, making forecasting possible for the first time.⁹⁹ Perhaps more importantly, recent DNA-hybridization techniques have made possible efficient identification of larvae to species-level-specificity.¹⁰⁰ Combining these techniques, NMFS could estimate the number of adult abalone, coral, or other species, that will mature at a given coastal site, given the model of the past year's larval dispersal. Using the biological information about each listed species, the agency could forecast a closure season for times and places of anticipated high larval density, and then sample the water in the days leading up to the anticipated closure with the new larval-identification techniques to validate the prediction. The agency could then provide these forecasts to other federal (as well as local) government officials to provide citizens notice of the species' presence and to facilitate local efforts to avoid take.¹⁰¹

This approach would minimize the economic and social disruption of the closures while maximizing their effectiveness. Primarily, however, this approach would function as a limitation on federally-permitted actions, and therefore would only address taking by federal actors. And as noted above, because marine invertebrates produce so many larvae, the species' populations could rebound after only a few good years of reproductive success, providing a template for species' recovery under the ESA.

3. Habitat Conservation Plans for the Ocean?

HCPs are by nature compromises. The HCP Handbook,¹⁰² a collaborative effort between NMFS and FWS, notes that “[w]hile species

99. See Heather M. Galindo, Donald B. Olson & Stephen R. Palumbi, *Seascape Genetics: a Coupled Oceanographic-Genetic Model Predicts Population Structure of Caribbean Corals*, 16 CURRENT BIOLOGY 1622 (2006); Kimberly A. Selkoe, Christine M. Henzler & Steven D. Gaines, *Seascape Genetics and the Spatial Ecology of Marine Populations*, 9 FISH AND FISHERIES 363 (2008); James R. Watson et al., *Realized and Potential Larval Connectivity in the Southern California Bight*, 401 MARINE ECOLOGY PROGRESS SER. 31 (2009); Crow White et al., *Ocean Currents Help Explain Population Genetic Structure*, 277 PROC. ROYAL SOC'Y SER. B 1685 (2010).

100. Email from Dr. Christy Henzler, Postdoctoral Fellow, U.C. Santa Barbara, to the author (Mar. 22, 2010) (on file with author).

101. Note that the California Department of Fish and Game now samples for Delta Smelt larvae and juveniles for four days every two weeks between January and March. See Cal. Dep't of Fish & Game, Smelt Larva Survey, <http://www.dfg.ca.gov/delta/projects.asp?ProjectID=SLS>.

102. U.S. FISH & WILDLIFE SERVICE AND NATIONAL MARINE FISHERIES SERVICE, HABITAT CONSERVATION PLANNING AND INCIDENTAL TAKE PERMIT PROCESSING HANDBOOK (Nov. 4, 1996), http://www.nmfs.noaa.gov/pr/pdfs/laws/hcp_handbook.pdf.

conservation is of course paramount, the Section 10 process recognizes the importance of both biological and economic factors.”¹⁰³ Given that the ESA expressly prioritizes species conservation over all other goals and disallows economic impact analysis for listing, HCPs transparently undermine conservation priorities for economic ones. Still, the HCP may be the best existing remedy for the challenge that invertebrate larvae pose to the ESA.

Because Section 10 provides only minimal HCP requirements, each plan is akin to a contract, individually suiting the needs of its parties. As a result, coastal stakeholders could leverage the HCP provision to craft a compromise that would sponsor listed species’ recovery without completely disrupting the various federal and non-federal activities that are common in coastal waters. Each party to the HCP would have an incentive to make the plan effective: conservationists want the species to recover and to protect the habitat; NMFS is legally required to conserve the species and wants to do so in a resource-effective way; industry would doubtless prefer the species recover quickly and be de-listed.¹⁰⁴ A large-scale HCP would work in conjunction with a high-level programmatic Section 7 consultation,¹⁰⁵ using a comprehensive evaluation of the human activities likely to take listed species within the ecosystem. NMFS is presently considering such a large-scale plan in an internal review, explicitly for the purpose of protecting coral larval settlement habitat.¹⁰⁶

An ambitious and effective HCP might tie the recovery of the listed species explicitly to the ongoing approval of the plan at fairly short renewal intervals rather than the customarily longer timeframes,¹⁰⁷ such that the permit holders would have to show (e.g., every three years) that the listed species was recovering or had recovered. If the species’ recovery stagnated at any point, NMFS could decline to renew the ITP, and the former permit holders would then be liable under Section 9 for any subsequent harm to listed species. The spatial extent of the HCP would be limited only by the listed species’ range and the number of

103. *Id.* at 1-7.

104. Plainly, these are broad-brush strokes, but they are meant to be illustrative of likely broad starting positions for interested parties.

105. *See supra* Part IV.

106. Moore’s views HCPs as an area of “unexplored potential” for coral conservation, particularly in connection with an effort to “restrict [ocean] activity to not occur during the spawning period” of the corals. Telephone Interview with Jennifer Moore, NOAA Field Office, St. Petersburg, Fla. (May 25, 2010).

107. 50 C.F.R. § 17.22(b)(4) (2010) requires that an HCP be of sufficient duration “to provide adequate assurances to the permittee to commit funding necessary for the activities authorized by the permit.” Here, the threat of penalties under Section 9 would be sufficient to ensure that the parties to the HCP would commit the necessary funding even over relatively short time intervals.

parties interested in receiving an ITP. Parties to the HCP negotiations could influence the structure of the deal, and newcomers could join either under existing terms or by participating in the next renewal negotiations. Actors not wishing to participate in the HCP would simply be subject to normal Section 9 provisions. Finally, agency monitoring could be funded by HCP-generated fees, potentially creating the side-benefit of a wealth of publicly-available data on ocean health.

In a stereotypical HCP agreement, a developer's proposed project would take some number of a listed species or its critical habitat. The agency would then work out a deal with the developer, often using off-site mitigation and monitoring, to salvage the species' protections while allowing the development to go forward.¹⁰⁸ Thus, there is a pervasive danger of the permit holder lacking sufficient conservation funds or failing to monitor in the future because his desired development has already occurred.¹⁰⁹

Not so, in the case of listed marine invertebrates. Because the pervasive nature of invertebrate larvae in the ocean creates the constant danger of take of listed species under the status quo, the agency would have great leverage to negotiate the terms of the HCP. Rather than seeking an exemption for a future project, the HCP applicant here is likely already violating the ESA. Ensuring adequate funding is not an issue, because if NMFS refused to renew the permit, the former permit holder would face large fines if it continued its activities.

Little case law is available to guide the terms of an HCP. At a minimum, however, the deals must "satisfy the ESA goal of conservation, which will allow the species to recover in order to 'reverse the trend to extinction.'"¹¹⁰ Presumably, NMFS's motivation to push for a protective, ambitious HCP is its legal duty to aid listed species in survival and recovery, while citizen suits serve to ensure that duty is carried out. Here, Section 9 provides perhaps a stronger incentive for private parties to agree on, and adhere to, a large-scale HCP.

The case of abalone may be an opportunity for innovative cooperation between commercial fisheries and federal managers. While disease and habitat loss are two central threats to abalone species along California's coast, poaching¹¹¹ is another: abalone are delicious. Of the

108. See, e.g., *Nat'l Wildlife Fed'n v. Babbitt*, 128 F. Supp. 2d 1274, 1278 (E.D. Cal. 2000) (discussing the Natomas Basin HCP near Sacramento, California).

109. *Id.*

110. *Sw. Ctr. for Biological Diversity v. Bartel*, 470 F. Supp. 2d 1118, 1129 (S.D. Cal. 2006) (citations omitted).

111. See BUTLER ET AL., NMFS STATUS REVIEW REPORT FOR BLACK ABALONE, Table 7 at 106 (January 2009), <http://www.nmfs.noaa.gov/pr/pdfs/statusreviews/blackabalone.pdf>.

handful of abalone species on the west coast of the United States, two are federally protected, but others are subject to intensive management by state governments.¹¹² At least three species are commercially farmed as food.¹¹³ Because there is such intense consumer demand, a fully recovered abalone stock is a potentially sustainable source of high-profit-margin commercial fishing.¹¹⁴ If commercial fisheries could be persuaded to join the recovery effort as an investment in a future source of income, the environmental groups and NMFS would gain a powerful ally in facilitating abalone recovery.

Discretion, tailoring, and HCPs can help to ensure that effective implementation of Section 9 is a primary protection mechanism for species under the ESA. However, Section 7, which requires federal agencies to consult with FWS or NMFS on discretionary actions that could negatively impact listed species or their habitat, provides separate protections, distinct challenges for safeguarding marine invertebrates, and further means of challenging federal actions that can harm such species.

IV. HOW DOES THE PRESENCE OF LARVAE AND JUVENILES AFFECT SECTION 7 CONSULTATION?

Implementing the ESA to manage increasingly-imperiled marine invertebrates will impact at least three aspects of the Section 7 consultation: (1) the jeopardy analysis, (2) the adverse modification analysis, and (3) the prospect for programmatic consultation between agencies. Additionally, dredge-and-fill permits under Section 404 of the Clean Water Act require Section 7 consultation and are worthy of separate consideration here.

Before discussing these provisions, it is important to distinguish between the listed coral species (for which NMFS has designated critical habitat) and the listed abalone species (for which NMFS has not). The latter are arguably subject to a lesser level of protection: whereas federal

112. Such as the Red Abalone, *Haliotis rufescens*. See, e.g., California Department of Fish & Game, *Abalone Information*, <http://www.dfg.ca.gov/marine/abalone.asp> (last visited Dec. 4, 2010).

113. Farmed abalone are considered a “best choice” by the influential Monterey Bay Aquarium Seafood Watch. See Monterey Bay Aquarium, *Seafood Watch: Abalone*, http://www.montereybayaquarium.org/cr/SeafoodWatch/web/sfw_factsheet.aspx (last visited Dec. 4, 2010).

114. Abalone, being snails that eat algae they graze from the rocks, are a reasonably sustainable food source from an ecological point of view. They were extremely common historically, supporting a commercial industry in California soon after statehood. See CALIFORNIA DIVISION OF FISH & GAME, BULLETIN NO. 30: THE COMMERCIAL FISH CATCH OF CALIFORNIA FOR THE YEAR 1929 (1931), <http://content.cdlib.org/ark:/13030/kt5199n7c0/>.

actions that adversely modify coral habitat could trigger a finding to that effect, and therefore require modification, only those actions that would actually jeopardize the continued existence of the abalone species would elicit a similar finding.

A. *Jeopardy*

An agency action would cause jeopardy if the action “reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.”¹¹⁵ The jeopardy definition suggests a relative scale of harm to a species, based upon the species’ biology. For species with small population sizes and few offspring, more minor harms are likely to trigger a “jeopardy” finding.¹¹⁶ Conversely, species with large populations and many offspring could absorb larger harms before being jeopardized.¹¹⁷

Marine invertebrates, however, fit uneasily into this scale: these species may produce millions of offspring with each generation, but each individual offspring has an extremely low probability of survival. As a result, harm to an individual larva will not appreciably affect the species’ overall likelihood of survival and recovery, but the aggregate harm to larvae by many independent actions might well doom the species altogether. Although under the ESA regulations and relevant case law NMFS/FWS must account for the cumulative impacts of human activities on endangered species,¹¹⁸ the analysis of cumulative impacts

115. 50 C.F.R. § 402.02 (2010). Note that this definition was struck down by *Gifford Pinchot Task Force v. U.S. Fish & Wildlife Serv.*, 378 F.3d 1059, 1069-70 (9th Cir. 2004), and has not been replaced, as discussed *infra*. Deleting “both” and replacing “and” with “or” gives a working definition.

116. Harming most listed vertebrates would easily fit this definition, as vertebrates tend to produce relatively few offspring per adult. Therefore harm to any given adult or offspring would reduce appreciably the likelihood of the species’ survival and recovery.

117. It is important to note here that endangered and threatened species, almost by definition, have small population sizes: that is why they are endangered.

118. See 50 C.F.R. §§ 402.12(f)(4), 402.14(g)(3)-(4). Note also that “cumulative effects” are not limited to the effects of federal actions; the regulatory definitions provide: “Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation.” 50 C.F.R. § 402.2. In both the Biological Assessment and Biological Opinion required by Section 7 consultation, NMFS or FWS is required to evaluate each federal action in light of the cumulative effects on the species or habitat. *Nat’l Wildlife Fed’n v. Nat’l Marine Fisheries Serv.*, 524 F.3d 917 (9th Cir. 2008) (holding the agency must take into account degraded baseline conditions and cumulative effects of actions on endangered species); *Gifford Pinchot Task Force v. U.S. Fish & Wildlife Serv.*, 378 F.3d 1059, 1063 (9th Cir. 2004) (“The [Biological Opinion] should address both the jeopardy and critical habitat prongs of Section 7 by considering the current status of the species, the environmental baseline, the effects of the proposed

often falls by the wayside, creating the danger of “death-by-a-thousand cuts.” Species with complex life cycles involving one or more larval stages, such as marine invertebrates and some anadromous fishes,¹¹⁹ therefore merit special analysis.

A species in population decline, by definition, produces fewer than two offspring surviving to adulthood for each of the adult breeding pairs.¹²⁰ Producing two surviving offspring per breeding pair is known as “replacement.” That is, the adults are merely replacing themselves, allowing the species to survive, but not to increase its population. A recovering species must reproduce faster than this. Therefore, a logical starting place for assessing whether the aggregate effect of federal actions will cause jeopardy is to ask whether these actions make it likely that fewer than two offspring per mating pair of adults will survive to reproduce.

If, for example, a breeding pair of abalone produces one million offspring,¹²¹ each with a one-in-a-million chance of survival,¹²² there is a 63.2 percent chance that at least one, and a 26.4 percent chance at least two, will survive.¹²³ However, if half of those larvae are entrained or otherwise killed by incidental take, the probability of at least one surviving drops to 39.3 percent, and to 9 percent for two or more

action, and the **cumulative effects** of the proposed action.”) (emphasis added); *Mausolf v. Babbitt*, 125 F.3d 661, 664 (8th Cir. 1997) (“FWS acknowledged that snowmobiler disruption of wolves while hunting prey, although likely insignificant in isolation, could lead to cumulatively significant negative effects if the disruptions were frequent.”).

119. Anadromous fishes are those that, like salmon, spend most of their lives in the ocean (or in the Great Lakes) and return to freshwater habitat to spawn. 50 C.F.R. § 401.2(g).

120. See, e.g., Thomas J. Espenshade, Juan Carlos Guzman, & Charles F. Westoff, *The Surprising Global Variation in Replacement Fertility*, 22 *POPULATION RES. & POL’Y REV.* 575, 575-583 (2003) (using the term “replacement-level fertility” to mark the break-even population point for human reproduction).

121. This is a fairly conservative estimate, given the “millions” of gametes released during each spawning event. See *Endangered Status for White Abalone*, 66 Fed. Reg. 29,046 (May 29, 2001) (codified at 50 C.F.R. pt. 224).

122. Note that this is a hypothetical survival rate for a *single breeding season*; replacement for stable population size requires only two new individuals per *generation* (i.e., over the reproductive lifetimes of a breeding pair). Individual abalone spawn millions of sperm and eggs at each spawning event, see *Endangered Status for White Abalone*, 66 Fed. Reg. at 29,046, and if males and females are sufficiently close to one another while spawning, millions of fertilization events could potentially occur, resulting in millions of larvae. Fertilization success depends upon the dilution of sperm and eggs in the water, among other factors, but can be very high: 80-100percent under reasonable conditions. See Maria C. Baker & Paul A. Tyler, *Fertilization Success in the Commercial Gastropod *Haliotis Tuberculata**, 211 *MARINE ECOLOGY PROGRESS SER.* 205 (2001) (reporting work on species of abalone closely related to those on the endangered species list).

123. Binomial probability distribution with 1×10^6 larvae and a $1/(1 \times 10^6)$ individual probability of survival.

surviving.¹²⁴ Although the long life spans of abalone¹²⁵ mean many chances to reproduce, such a drastic annual diminishment of larval supply would doubtless put survival in jeopardy.

Conversely, improving the baseline larval survival rate slightly, through assisted breeding or other affirmative steps, could quickly make demographic recovery possible. For example, raising the survival rate to two-in-one-million results in an 86.5 percent chance of producing at least one survivor, and 59.4 percent of producing at least two.¹²⁶ This would make demographic replacement for any given pair of individuals more likely than not, within a single breeding season. Such a success rate would go a long way towards helping these species recover to the point where they no longer require protection, the stated goal of the ESA.¹²⁷

Calculating the overall effect of federal actions on survival, of course, is the cumulative impacts analysis. In this way NMFS can evaluate a species' expected survival rate by determining how many adults and larvae that *all* agency actions might kill *in the aggregate*. Such an overall analysis seems especially prudent after the Ninth Circuit court's admonition in *National Wildlife Federation v. NMFS* that "[using NMFS's degraded baseline] approach, a listed species could be gradually destroyed, so long as each step on the path to destruction is sufficiently modest. This type of slow slide into oblivion is one of the very ills the ESA seeks to prevent."¹²⁸

In the case of marine invertebrates, this analysis might entail using species-specific modeling and reported levels of seawater intake (for sources of larval mortality such as cooling-water for power plants) and industrial output (for sources of pollution that would negatively impact larvae, often already permitted through the Clean Water Act) for all federal actions affecting the listed species. Because of recent advances in genetic tagging and other techniques,¹²⁹ the best available science makes it possible to identify and count, in near-real-time, the larvae

124. Binomial probability distribution with 1×10^6 larvae and a $1/(0.5 \times 10^6)$ individual probability of survival.

125. See Endangered Status for White Abalone, 66 Fed. Reg. at 29,046 (estimating the white abalone life span at 30 years or more).

126. Binomial probability distribution with 1×10^6 larvae and a $2/(1 \times 10^6)$ individual probability of survival.

127. See 16 U.S.C. § 1532 (2006) (defining "conservation" as "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 chapter are no longer necessary.").

128. *Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv.*, 524 F.3d 917, 930 (9th Cir. 2008). Using a consistently-degrading environment's status quo as the baseline of any analysis is problematic for this reason.

129. Email from Dr. Christy Henzler, Postdoctoral Fellow, U.C. Santa Barbara, to the author (Mar. 22, 2010) (on file with author).

actually killed by a given activity. Spot-checking sources of larval mortality would then minimize the regulatory burden of validating the models, and would allow the agency to more precisely assess the cumulative impact of federal actions on the species. If individual ITPs or ITSs were conditioned on reasonable levels of take (e.g., such that they would cause no more than a tiny percentage diminution in larval supply), federal and federally-permitted actions could continue safely in the presence of the endangered species, and the permit could be withdrawn if too many larvae were killed by a given action.¹³⁰

Frustratingly, the cumulative level of take that causes jeopardy will vary by species, depending upon a host of factors including its fecundity, fertilization success, and larval settlement and survival rates. Additionally, a jeopardy decision remains, at least to some degree, a political judgment because it is a risk-management decision with the threshold level of acceptable extinction risk set by policy.¹³¹ However, the jeopardy decision is most transparently done, and most likely to withstand judicial scrutiny, if it is made using rational criteria backed by data. Quantitative risk analysis is therefore valuable, and is especially critical in the case of species with probabilistic and stochastic larval survival rates.

Perhaps the agencies can most profitably do such an analysis by folding in the cumulative impacts assessment, described above, into a larger Population Viability Analysis (PVA). PVA is often associated with a listing decision,¹³² e.g., whether a species is endangered, threatened, or neither, or species recovery plans.¹³³ PVA, however, is just as useful for evaluating the potential impact of issuing an ITP on the population of a listed species.¹³⁴ Again, the approach requires modeling for each individual species, though if the agency has already done this modeling in making the original listing decision or recovery plan, or in the course of Section 7 consultation, reusing the model to assess overall

130. See generally 50 C.F.R. § 402.14 (2010) (indicating that if individual ITPs or ITSs were conditioned on reasonable levels of take they would not affect listed species or critical habitats).

131. See Daniel J. Rohlf, *Jeopardy Under the Endangered Species Act: Playing A Game Protected Species Can't Win*, 41 WASHBURN L.J. 114, 158-159 (2001).

132. See, e.g., Grant G. Thompson, NOAA Technical Memoranda NMFS-F/NWC-198: Determining Minimum Viable Populations under the Endangered Species Act (June 1991), <http://www.nwfsc.noaa.gov/publications/techmemos/tm198/index.html>.

133. See, e.g., Cheryl B. Schultz & Paul C. Hammond, *Using Population Viability Analysis to Develop Recovery Criteria for Endangered Insects: Case Study of the Fender's Blue Butterfly*, 17 CONSERVATION BIOLOGY 1372, 1372-85 (2003).

134. See, e.g., J. Michael Reed et al., *Emerging Issues in Population Viability Analysis*, 16 CONSERVATION BIOLOGY 7, 7-13 (2002) (suggesting that Population Viability Analysis is most appropriate for comparing the expected outcomes of different management actions).

population viability would not be a technical burden and would form a quantitative and rational basis for decision-making. NMFS already does similar modeling for some fish species, including Columbia River salmon species,¹³⁵ and in that context has developed a means of accounting for their low baseline survival rate.¹³⁶ In sum, the jeopardy analysis requires that the agency know enough about the individual species to model the species' demographics, both to assess individual ITs and to weigh the cumulative impacts of all federal actions on the species' chances of survival.

1. Proximate Cause and Jeopardy

A proximate cause problem remains, apart from the related cumulative impacts analysis. Even if the aggregate effect of federal actions obviously puts a species in jeopardy, Section 7 consultation takes place for each individual federal action and it is not clear that any one of these actions, standing alone, puts the species in jeopardy. A failure to assign causation altogether, e.g., to permit an indefinite number of actions, each of which harms the species in some small way, would be to vitiate Section 7 and to undermine the purpose of the Act itself. At least two ways of assessing causation provide an outcome more consistent with the ESA's purpose.

First, the Ninth Circuit's recent holding in *National Wildlife Federation v. NMFS* indicates that any "additional harm" to a species already in jeopardy of extinction cannot be permitted.¹³⁷ Under this analysis, all actions contributing to a threshold level of cumulative incidental take would be allowed, but beyond that threshold—after a species is in jeopardy—all actions would be barred. This scenario would lead to a race to the administrative agency, as those who consulted earliest would be the most likely to receive ITs. To the extent that early

135. See NOAA FISHERIES, CONSULTATION ON REMAND FOR OPERATION OF THE FEDERAL COLUMBIA RIVER POWER SYSTEM, 11 BUREAU OF RECLAMATION PROJECTS IN THE COLUMBIA BASIN AND ESA SECTION 10(a)(1)(A) PERMIT FOR JUVENILE FISH TRANSPORTATION PROGRAMS 7-6 (May 5, 2008) [hereinafter COLUMBIA RIVER CONSULTATION].

136. This technique, known as "Age-1-Equivalents" or "Equivalent Adult Modeling" is an actuarial solution to r-selected species. It requires species-specific modeling and is done to estimate the impacts of power plant entrainment/impingement on fish species' adult populations given their larval survival rates. See, e.g., RAY BEAMESDERFER, VIABILITY STATUS OF OREGON SALMON AND STEELHEAD POPULATIONS IN THE WILLAMETTE AND LOWER COLUMBIA BASINS, APP. F: POPCYCLE MODEL DESCRIPTION 10 (June 25, 2007), http://www.nwfsc.noaa.gov/trt/trt_documents/appendix_f.pdf.

137. *Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv.*, 524 F.3d 917, 930 (9th Cir. 2008) (also stating that "even where baseline conditions already jeopardize a species, an agency may not take action that deepens the jeopardy by causing additional harm").

and forthright consultation is consistent with the ESA's statutory purpose, such a race to the agency is in many ways desirable. However, if the agencies awarded long-term ITPs, creating vested rights to take listed species for years into the future, it could allow the permit holders exclusive rights to particular actions and paralyze government activities in the future. One solution to the vesting problem would be short-term ITPs, renewable with a streamlined consultation.

The agency could also assign causation by borrowing from tort law, which has long involved analyses of incremental or probabilistic harm. There is a close analogy between marginal, cumulative harm to listed species and the way in which courts have employed market-share and joint-and-several liability regimes to assign responsibility for the diffuse harms of modern torts. For example, as in the case of a drug that caused birth defects, in which the California Supreme Court ultimately assigned damages based upon the national market-share of each pharmaceutical company producing the drug,¹³⁸ in the ESA context the agency might revoke the ITP for any action causing a significant portion of the risk to species survival and recovery. Or, as in the case of a joint-and-several liability scheme,¹³⁹ the agency might theoretically revoke all outstanding ITPs if the cumulative impact put the species in jeopardy.¹⁴⁰ One author has recently proposed such tort-like analysis in the climate change context, assigning fractional responsibility for a diffuse harm.¹⁴¹

However, tort damages do not prevent harm from occurring in any particular case. Rather, they compensate those harmed by tortious conduct. Here, the ESA requires that federal actions not put the species in jeopardy (Section 7) and that no one harm listed species (Section 9). Taking the analogy a step further, the ESA remedy would differ from torts by requiring actual harm-avoidance in the form of denial or revocation of ITPs. Like many cases of nuisance, this is a harm that demands injunctive relief of some kind. In the case of listed marine invertebrates, an uncomfortable fact is that, by killing any larvae at all, each federal action is reducing the species' potential for survival and for

138. See generally *Borel v. Fibreboard Paper Prod. Corp.*, 493 F.2d 1076 (5th Cir. 1973); *Sindell v. Abbott Lab.*, 26 Cal. 3d. 588 (Cal. 1980); see also Matthew Gerhart, *Change and the Endangered Species Act: The Difficulty of Proving Causation*, 36 *ECOLOGY L.Q.* 167, 187 (2008) (using asbestos litigation damages in the context of climate change).

139. See generally *Am. Motorcycle Ass'n v. Super. Ct.*, 20 Cal. 3d. 578 (Cal. 1978) (establishing joint-and-several liability with partial indemnity from co-tortfeasors in California).

140. Clearly, such a mass-revocation would fail given political realities, and would violate the "no surprises" rule underlying Habitat Conservation Plans under ESA Section 10, 16 U.S.C. § 1539 (2006).

141. For a discussion of assigning causal responsibility under the ESA in the context of climate change, see Gerhart, *supra* note 138, at 187.

recovery. Thus causation is more easily established than in the climate change context because an action is definitely and proximately killing a listed species when it kills a larva, the precise harm the ESA intends to prevent. The remedy, however, will be tricky to implement.

2. Salmonids as an Analogous Jeopardy Analysis

Section 7 consultation for endangered/threatened steelhead and salmon provides a glimpse of what will be required for a jeopardy analysis for marine invertebrates. Like their invertebrate counterparts, these listed fish species spawn annually and give rise to many thousands¹⁴² of young per breeding pair of adults, each larva having a small chance of survival. NMFS's practice has been to require an assessment of incidental take of fish larvae and fry as part of Section 7 consultation for federal actions in these habitats.¹⁴³ Large levels of incidental take are especially common in power plant cooling water intake structures. Although the agency does explicitly address salmonid larval and juvenile mortality in its ITSs, the difficulty and expense of monitoring larval entrainment have limited NMFS' assessment of mortality.

For example, in its 2008 ITS for the Federal Columbia River Power System, NMFS characterized its evaluation as follows: "NOAA Fisheries will compare the results of annual in-river survival studies . . . to the averages and ranges [of levels of take] provided in these tables to assess whether or not the authorized incidental take allowed under this Opinion has been exceeded."¹⁴⁴ That is, the agency sets a range of acceptable survival levels for particular modeled species, and authorizes incidental larval take as long as the ground-truthing indicates the levels are met. For a suite of other species, presumably harder to model and

142. See Michael C. Healey & William R. Heard, *Inter- and Intra-Population Variation in the Fecundity of Chinook Salmon (*Oncorhynchus tshawytscha*) and its Relevance to Life History Theory*, 41 CAN. J. FISHERIES AQUATIC SCI. 476, 480 (1984) (showing one species spawning between about 3,000 and 10,000 eggs per individual).

143. See, e.g., DELTA SMELT BIOP, *supra* note 97, at 389 (analysis of larval and juvenile take by year).

144. COLUMBIA RIVER CONSULTATION, *supra* note 135, at 14-5; see also NOAA FISHERIES, CONSULTATION FOR THE OPERATION AND MAINTENANCE OF 10 U.S. BUREAU OF RECLAMATION PROJECTS AND 2 RELATED ACTION IN THE UPPER SNAKE BASIN ABOVE BROWNLEE RESEVOIR 13-3 (May 5, 2008) (In a case in which the agency authorized monitoring by proxy, NOAA Fisheries stated "[a]lthough likely to occur, NOAA Fisheries finds that it is not feasible to quantitatively monitor the amount of take expected solely as a result of this action, but expects that take will be inversely proportional to the amount (and proportional to quality) of flows resulting from upriver water management, including that of Reclamation. Therefore, NOAA Fisheries will consider Reclamation is not exceeding its authorized take so long as flows are provided at levels (and of a quality) expected by the analysis in this Opinion.").

monitor, the agency did not monitor directly and instead authorized incidental take of these species as long as the applicant met the technical requirements for dam operation contained in its permit application.¹⁴⁵

Such a technology- or operations-based standard is reminiscent of the Clean Water Act, which provides another approach to regulating take of larval and juvenile forms that may be useful in the ESA context. In 1999, the EPA estimated cooling water intake at power facilities totaled over 214 billion gallons of water per day from the waters of the United States, comprising nearly half of total withdrawals from combined freshwater and saline sources.¹⁴⁶ These withdrawals kill an estimated 3.4 billion individual fish and shellfish (i.e., invertebrates) per year.¹⁴⁷ If even a small number of those killed are endangered or threatened, withdrawal of cooling water has an enormous impact on survival and recovery of listed species. The fact that withdrawals kill thousands of imperiled fishes in the San Francisco Bay Delta alone¹⁴⁸ indicates that this is a real threat.

The EPA has therefore promulgated regulations limiting cooling-water intake at power facilities, requiring the best technology available, and setting performance standards for reduction of mortality.¹⁴⁹ While these standards are useful as a gauge of efforts to minimize take and habitat destruction, it is not clear that such technology-based standards are consistent with the ESA's statutory terms. Given that FWS and NMFS must "insure" that a listed species is not put in jeopardy or that critical habitat is not adversely modified,¹⁵⁰ using the best technology available without an outcome-based criterion is inadvisable.¹⁵¹

145. See COLUMBIA RIVER CONSULTATION, *supra* note 135, at 14-5 ("Quantitative estimates of take are not possible for the spawning and incubation stages of SR fall Chinook, LCR Chinook, and CR chum salmon. The incidental take of these species will be considered authorized if flow operations are implemented as described [above, in a particular strategy for dam operation]. Similarly, due to the inherent uncertainties in estimating survival created by [one of its life history strategies], the take of juvenile SR fall Chinook salmon will be considered authorized as long as the flow and dam operations are implemented, as described [above, in a broader range of dam operation scenarios].") In general, if the agency establishes non-numeric targets, it must justify this decision. See *Or. Natural Res. Council v. Allen*, 476 F.3d 1031, 1037 (9th Cir. 2007); *Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv.*, 235 F. Supp. 2d 1143, 1160 (W.D. Wash. 2002).

146. Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities, 69 Fed. Reg. 41,576, 41,586 (July 9, 2004).

147. *Id.*

148. See *id.* at 41,587.

149. 40 C.F.R. §§ 125.94, 125.99 (2010).

150. 16 U.S.C. § 1536(a)(2) (2006).

151. For a discussion of Clean Water Act standards and the entrainment of larval and juvenile organisms, see *generally* *Riverkeeper, Inc. v. Env'tl. Protection Agency*, 475 F.3d 83 (2d Cir. 2007), *rev'd sub nom.* *Entergy Corp. v. Riverkeeper, Inc.*, 129 S. Ct. 1498 (2009).

B. *Adverse Modification of Critical Habitat*

Even if a proposed federal action will not put a species in jeopardy, the ESA requires the action not destroy or adversely modify listed species' critical habitat. Once the agency designates a species' critical habitat, as NMFS has done for corals but not for abalone, any federal agency action that will adversely modify that habitat is subject to Section 7 consultation. As in the case of a jeopardy finding, if the BiOp concludes that the proposed project would destroy or adversely modify critical habitat, the secretary will suggest "reasonable and prudent alternatives" to the proposed action, in order to mitigate the project's impact,¹⁵² and issue an ITS.¹⁵³

The ESA regulations give the agencies wide latitude to decide whether an action will adversely modify habitat, defining adverse modification as that which "appreciably diminishes" the value of the habitat.¹⁵⁴ Precisely which actions and how much degradation "appreciably diminishes" the value of the habitat are bound to be judgment calls, but the agency must have a rational basis for its decision in order to avoid having the decision vacated as arbitrary and capricious.¹⁵⁵ While agency guidelines set out a framework for the analysis in the absence of new regulations after *Gifford Pinchot*,¹⁵⁶ NMFS and FWS evaluate actions on a case-by-case basis, and the contours of the doctrine are hazy.

Marine invertebrates challenge the adverse modification analysis mainly because, as discussed further in part V *infra*, their habitat consists

152. 16 U.S.C. §1536(b)(3)(a).

153. 16 U.S.C. §1536(b)(4); *see also* *Or. Natural Res. Council v. Allen*, 476 F.3d 1031, 1040 (9th Cir. 2007) (holding that the agency must issue an incidental take statement if the federal action will not cause jeopardy to the species or adversely modify its designated critical habitat).

154. *See* 50 C.F.R. § 402.02 (2010). Note that this definition was struck down by *Gifford Pinchot Task Force v. U.S. Fish & Wildlife Serv.*, 378 F.3d 1059, 1070 (9th Cir. 2004), but has not been replaced. Replacing the language 'appreciably diminishes the value of the critical habitat for both the survival and recovery of a listed species' with 'appreciably diminishes the value of the critical habitat for either the survival or the recovery of a listed species,' as the Center for Biological Diversity has recently proposed, would bring the regulation into line with *Gifford Pinchot Task Force*, 378 F.3d at 1070, and *Wildlife Fed'n v. Nat'l Marine Fisheries Serv.*, 524 F.3d 917 (9th Cir. 2008).

155. *Natural Res. Def. Council v. U.S. Forest Serv.*, 421 F.3d 797, 806 (9th Cir. 2005) ("The Forest Service must state a rational connection between the facts found and the decision made." (quoting *Gifford Pinchot Task Force*, 378 F.3d at 1065) (internal quotation marks omitted)).

156. MEMORANDUM FROM ACTING DIRECTOR MARSHALL JONES OF THE U.S. FISH & WILDLIFE SERVICE TO REGIONAL DIRECTORS, APPLICATION OF THE "DESTRUCTION OR ADVERSE MODIFICATION" STANDARD UNDER SECTION 7(A)(2) OF THE ENDANGERED SPECIES ACT (Dec. 9, 2004), <http://www.fws.gov/midwest/endangered/permits/hcp/pdf/AdverseModGuidance.pdf>.

of both the hard substrate (mainly in the case of adults), and the water above or surrounding that substrate (in the case of larvae, juveniles, or adults, depending on the species). Because marine habitats encompass these two very different aspects, they are in a sense twice as vulnerable as their purely terrestrial counterparts: adverse modifications to either the substrate or the water will result in harm to the species.¹⁵⁷ Any analysis of whether a federal action adversely modifies critical habitat therefore clearly depends upon whether that habitat can be construed to include the water itself in addition to the substrate, a question discussed further in part V of this paper. For reasons I make clear there, critical habitat necessarily should include the water column, as well as the sea floor.

Impacts to the substrate portion of the critical habitat are probably not analytically distinct from such impacts for terrestrial species. But, the water above the substrate is qualitatively different: it is a three-dimensional, ever-changing group of molecules, with complications familiar from Clean Air Act (“CAA”) and Clean Water Act (“CWA”) case law. Marine neritic and pelagic habitat¹⁵⁸ is subject to water-current flows akin to upstream-downstream river conflicts under the CWA¹⁵⁹ or transboundary air quality issues under the CAA.¹⁶⁰ The impacts of diffuse pollutants present the same issues as in the CWA, and in many cases the CWA itself actually applies. As a result, if marine species’ critical habitat includes the water itself, as it logically must,¹⁶¹ Section 7 consultation promises both to become more analytically complex (given the upstream-downstream dynamic) and further reaching, impacting a larger number of federal actions along the coast. Some of the many routine federal agency actions could constitute an adverse modification include approving and issuing water quality standards under the CWA

157. Perhaps a good terrestrial analogy is air quality at critical habitat sites for endangered species: toxic air would no doubt harm the species, but it’s not clear that any defined critical habitat explicitly includes air quality.

158. *I.e.*, the water portion of offshore habitat, not including the substrate.

159. *See, e.g.*, Neil Fairweather, *Arkansas v. Oklahoma: Downstream States Left Without a Paddle*, 9 J. NAT. RESOURCES & ENVTL. L. 189 (1993-1994); Maria V. Maurrasse, *Oklahoma v. EPA: Does the Clean Water Act Provide an Effective Remedy to Downstream States or Is There Still Room Left for Federal Common Law?*, 45 U. MIAMI L. REV. 1137 (1991).

160. *See, e.g.*, Brenda J. Nordenstam et al., *A Framework for Analysis of Transboundary Institutions for Air Pollution Policy in the United States*, 1 ENVTL. SCI. & POL’Y 231 (1998); Richard L. Revesz, *Federalism and Interstate Environmental Externalities*, 144 U. PENN. L. REV. 2341 (1996).

161. *See infra* Part V, and note also that the examples in 50 C.F.R. § 424.12 (2010) (“water quality or quantity . . . tide”) indicate the water itself is eligible to be designated critical habitat.

(and perhaps NPDES permits),¹⁶² drilling/mineral extraction,¹⁶³ dredging/filling under Section 404 of the CWA,¹⁶⁴ and the management of commercial fishing under the Magnusson-Stevens Act.¹⁶⁵

After *National Association of Home Builders*,¹⁶⁶ it seems likely that state-issued NPDES permits do not trigger Section 7 consultation.¹⁶⁷ If they did, thousands of additional consultations per year for FWS and

162. In states and territories not certified to issue their own permits, the federal Environmental Protection Agency issues these permits, *see* 33 U.S.C. § 1342 (2006), unambiguously a federal action subject to ESA Section 7 consultation. Most important of these for listed marine invertebrates are the Pacific territories of Guam and American Samoa (as well as smaller territories) and the Caribbean territory of Puerto Rico: each of these provides habitat for coral species either already listed or else otherwise imperiled.

163. Undersea set-up and take-down operations seem especially likely to adversely modify the marine habitat, and the recent oil slick from a British Petroleum rig in the Gulf of Mexico illustrates the enormous risk to this habitat that even well-established industries represent.

164. Discussed directly *infra*.

165. 16 U.S.C. §§ 1801-1891 (2006). Here, the scope of analysis for Section 7 would be enormous. It would focus on whether all federally-permitted commercial fishing activity, in the aggregate, would adversely modify the habitat of listed species. This might include an ecological analysis of direct effects on the listed species—such as whether oil leaks and leaded paint from the sum total of the fishing fleet adversely modify a species environment—as well as more indirect effects, such as whether harvesting millions of tons of one fish species changes marine food webs in such a way as to negatively impact habitat or the species itself. Some fishery management plans already undergo Section 7 consultation. *See, e.g.*, NATIONAL MARINE FISHERIES SERVICE, ENDANGERED SPECIES ACT—SECTION 7 CONSULTATION BIOLOGICAL OPINION FOR THE CONTINUED AUTHORIZATION OF REEF FISH FISHING UNDER THE GULF OF MEXICO (GOM) REEF FISH FISHERY MANAGEMENT PLAN (RFFMP) AND PROPOSED AMENDMENT 23 (Feb. 15, 2005), http://www.flmnh.ufl.edu/fish/sharks/sawfish/srt/ReefFish_BO.pdf.

166. *Nat'l Ass'n of Home Builders v. Defenders of Wildlife*, 551 U.S. 644, 650, 650 n.1 (2007) (The Court stated that “state officials—not the federal EPA—have the primary responsibility for reviewing and approving NPDES discharge permits, albeit with continuing EPA oversight,” and that “[t]he State must advise the EPA of each permit it proposes to issue, and the EPA may object to any permit. If the State cannot address the EPA’s concerns, authority over the permit reverts to the EPA.”) (citations omitted). If the EPA’s objection to a NPDES permit reverted authority to the federal level, issuing the resulting permit would presumably be a federal action subject to ESA Section 7.) It is nevertheless EPA policy to undergo Section 7 consultation for NPDES permits it issues. Memorandum of Agreement Between the Environmental Protection Agency, Fish & Wildlife Service and National Marine Fisheries Service Regarding Enhanced Coordination Under the Clean Water Act and Endangered Species Act, 66 Fed. Reg. 11,202, 11,202 (Feb. 22, 2001) (codified at 50 C.F.R. pt. 402.14(c), 402.14(g)(3) and (4), 402.14(h) (2010)).

167. Note, however, that the EPA views Section 7 consultation as necessary when approving state water quality standards. Memorandum of Agreement Between the Environmental Protection Agency, Fish & Wildlife Service and National Marine Fisheries Service Regarding Enhanced Coordination Under the Clean Water Act and Endangered Species Act, 66 Fed. Reg. at 11,206 (“We believe that where approval of new or revised [state water quality] standards may have an effect on a listed species or designated critical habitat, consultation under Section 7(a)(2) is required.”).

NMFS¹⁶⁸ would require states to ensure their cumulative NPDES-permitted pollution into the oceans would not appreciably diminish the habitat of listed species. Because larvae are likely to be the life stage most sensitive to pollution,¹⁶⁹ in practice this would mean calibrating the total pollution load to the requirements of listed species' larvae.¹⁷⁰

National Association of Home Builders makes this scenario less likely, as state NPDES permits are probably not federal actions and thus they do not require Section 7 consultation. However, state NPDES permits are nevertheless subject to Section 9 take provisions,¹⁷¹ making states liable for any listed species killed as a result of permitted pollution. This interaction of the ESA and the CWA with respect to pollution-sensitive larvae is one means of challenging state actions (or perhaps even non-actions) that permit nonpoint source pollution to reach the coastal oceans.

The EPA's establishment of national water quality standards¹⁷² is more clearly a federal action subject to Section 7 consultation, as are the federal EPA actions in approving state water quality standards or promulgating standards for particular states and territories that have not themselves done so.¹⁷³ These consultations further entwine the often-distinct concepts of water quality and endangered species protections,

168. California alone had 1,845 NPDES permits outstanding at the time of this writing. California Integrated Water Quality Systems Project (CIWQS), Interactive Regulated Facilities Report, <http://ciwqs.waterboards.ca.gov/ciwqs/readOnly/ciwqsReportRegulatedFacilities.jsp> (last visited Dec. 4, 2010).

169. The small size of larvae means that they have an extremely high-surface-area-to-volume ratio, and hence have a greater percentage of their body mass directly exposed to the environment. Moreover, they have diaphanous, usually permeable shell layers, making them vulnerable. Finally, there is a large experimental literature on the susceptibility of larvae to pollutants. See, e.g., Andrew Beaumont and M.D. Budd, *High Mortality of the Larvae of the Common Mussel at Low Concentrations of Tributyltin*, 15 MARINE POLLUTION BULLETIN 402 (1984); Charles L. McKenney, Jr. and Edward Matthews, *Influence of an Insect Growth Regulator on the Larval Development of an Estuarine Shrimp*, 64 ENVTL. POLLUTION 169 (1990) (finding "[t]he first two larval stages and the final premetamorphic larval stage were more sensitive to methoprene toxicity than intermediate larval stages"); George Verriopoulos and Maria Moraitou-Apostolopoulou, *Differentiation of the Sensitivity to Copper and Cadmium in Different Life Stages of a Copepod*, 13 MARINE POLLUTION BULLETIN 123 (1982).

170. See *Miccosukee Tribe of Indians of Fla. v. United States*, 566 F.3d 1257, 1270-71 (11th Cir. 2009) (noting that which modifications are adverse depends upon the life cycle of the focal species: "adverse modification must be measured by taking into account the life cycle and behavioral pattern of the endangered species in question.").

171. See *supra* Part III (discussing ESA Section 9, 16 U.S.C. § 1538 (2006)).

172. 40 C.F.R. § 131.22(b) (2010).

173. See, e.g., Water Quality Standards for Oregon, 68 Fed. Reg. 58,758, 58,758 (proposed Oct. 10, 2003) (codified at 40 C.F.R. pt. 131); Water Quality Standards for Puerto Rico, 72 Fed. Reg. 70,517, 70,517 (Dec. 12, 2007) (codified at 40 C.F.R. pt. 131.40 (2010)).

particularly where the survival of an endangered species (such as the listed invertebrates) depends upon the integrity of coastal water quality.

Although pollutant discharges are often temporary and discrete events, temporary habitat modification nevertheless can fall afoul of the ESA.¹⁷⁴ In the case of NPDES permits or insufficiently protective water quality standards, the combination of diffuse water pollution and temporary discharges could lead to difficulty in tracing causality, as in the jeopardy analysis. Nevertheless, the best existing scientific data on the larval mortality as a function of toxin concentration provide a guide for discharge permitting: if all discharges combined are likely to cause mortality in listed species' larvae by adversely modifying its water-phase habitat, issuing the permit would trigger ESA Sections 7 and 9.¹⁷⁵ Fractional responsibility for such modification, discussed above in the case of jeopardy to a listed species, could similarly borrow from causation analysis of tort law.

NMFS's critical habitat designation for both listed coral species has yet to cause Section 7 difficulties, inspiring neither published judicial decisions nor notices in the Federal Register to date.¹⁷⁶ This may be due to the designated habitats being interpreted as being restricted to parts of the sea floor, rather than including the water itself,¹⁷⁷ or else due to the fact that the agency only designated the habitat fairly recently. More likely, however, is that the federal agencies operating within the designated habitat, which encompasses much of Florida's southern coast as well as the coastlines of the U.S. Caribbean territories,¹⁷⁸ have not yet appreciated that they are subject to the requirement.

C. Programmatic Consultation

The availability of programmatic consultation—that is, simultaneous consultation on multiple, related federal actions—might

174. See *Miccosukee Tribe*, 566 F.3d at 1270 (holding temporary impacts may adversely modify habitats).

175. The EPA, NMFS, and FWS expressly acknowledged that Section 7 consultations for actions under the Clean Water Act would consider the action's cumulative effects. Memorandum of Agreement Between the Environmental Protection Agency, Fish & Wildlife Service and National Marine Fisheries Service Regarding Enhanced Coordination Under the Clean Water Act and Endangered Species Act, 66 Fed. Reg. 11,202, 11,202 (Feb. 22, 2001) (codified at 50 C.F.R. pt. 402.14(c), 402.14(g)(3) and (4), 402.14(h) (2010)).

176. Telephone Interview with Jennifer Moore, Policy Analyst, Nat'l Oceanic & Atmospheric Admin., St. Petersburg, Fla. Field Office (May 24, 2010) (No Section 7 consultations have taken place in connection with the critical habitat for the two coral species.).

177. See discussion *infra* Part V.A and note 216.

178. Critical Habitat for Threatened Elkhorn and Staghorn Corals, 73 Fed. Reg. 72,210, 72,214 (Nov. 26, 2008) (codified at 50 C.F.R. pt. 223, 226).

also have implications for listed marine invertebrates.¹⁷⁹ Programmatic consultations, such as those for the large-scale Land and Resource Management Plans that the United States Forest Service and the Bureau of Land Management conduct,¹⁸⁰ streamline the ESA's Section 7 requirements by allowing a consulting agency to get wholesale approval from NMFS or FWS for its specified foreseeable actions.¹⁸¹ In order to avoid harm to listed marine invertebrates or their habitat, federal agencies could request an ecosystem-level consultation for the nearshore marine environment.¹⁸² Although such a broad-brush consultation would likely require individual site-specific consultations,¹⁸³ it would be an opportunity to efficiently address some of the unique challenges these species present: setting, for example, total acceptable levels of incidental take, ecosystem-wide. The Section 7 Handbook explicitly contemplates these benefits, noting that they are particularly appropriate in areas undergoing large-scale HCPs.¹⁸⁴

Using ecosystem-level programmatic consultation to account for the aggregate harm to a species or its habitat across all reasonably foreseeable federal actions could help avoid the death-by-a-thousand-cuts problem. However, the massive scale on which many species would require consultation would probably be prohibitive for NMFS and FWS. Previous ecosystem-level programmatic consultations have been smaller, such as those focusing on stretches of single large rivers,¹⁸⁵ and it would take an ambitious agency to consult broadly for all foreseeable actions that might impact listed marine species.¹⁸⁶

179. U.S. FISH & WILDLIFE SERVICE AND NATIONAL MARINE FISHERIES SERVICE, ENDANGERED SPECIES CONSULTATION HANDBOOK: PROCEDURES FOR CONDUCTING CONSULTATION AND CONFERENCE ACTIVITIES UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT xvii (1998) (defining "programmatic consultation" as "consultation addressing an agency's multiple actions on a program, regional or other basis"), <http://www.fws.gov/caribbean/es/PDF/Sec%207%20Handbook.pdf> [hereinafter SECTION 7 HANDBOOK].

180. See FOREST SERVICE MOA, *supra* note 32.

181. See, e.g., Gifford Pinchot Task Force v. U.S. Fish & Wildlife Serv., 378 F.3d 1059 (9th Cir. 2004) (upholding programmatic BiOps for timber sales in spotted owl habitats).

182. See SECTION 7 HANDBOOK, *supra* note 179, at 5-5.

183. This will depend upon how the relevant agencies interpret the programmatic consultation's tiering. The Handbook suggests that site-specific actions will require additional consultation under the "umbrella of the larger planning document," *id.* at 4-51, but the Forest Service MOA claims that management actions in each Forest Service Unit can "tier to the programmatic consultation with no further consultation." See FOREST SERVICE MOA, *supra* note 32, at 9.

184. SECTION 7 HANDBOOK, *supra* note 179, at 5-5, 6. Habitat Conservation Plans discussed *infra* Part V.

185. SECTION 7 HANDBOOK, *supra* note 179, at 5-5.

186. But note that the programmatic consultation over roads in National Forests encompassed over 10 million acres, surely an ambitious effort.

The other drawback of high-level programmatic consultation is the danger of losing accountability at the level of individual actions. Ecosystem-level limits for larval take, viable population sizes, and water-borne pollution loads would be useful as metrics for judging the impacts of individual federal actions. But if consultation and monitoring were also required for each particular action, as would be prudent given the uncertainty of the relevant critical population sizes and adverse effects of particular actions, the agencies would have little incentive to do a large programmatic consultation. It is also worth noting that an ecosystem-level consultation done with liberal assumptions about impacts to species and having no action-level consultation requirement would be an especially fraught scenario.

D. Wetlands: Dredge and Fill Permits under the Clean Water Act

The Clean Water Act (“CWA”) represents a final wrinkle for Section 7 interpretation because it governs the other major activity likely to cause take of listed marine species. Under Section 404 of the CWA¹⁸⁷ and a joint memorandum between the Army Corps of Engineers and the EPA,¹⁸⁸ the Corps is responsible for issuing permits for any dredge or fill operations in the navigable waters of the United States.¹⁸⁹ The practice of issuing such permits is a federal action, and therefore triggers Section 7 consultation under the ESA. The Corps may not issue a Section 404 permit if the proposed action would put a listed species in jeopardy or would adversely modify critical habitat.¹⁹⁰

187. 33 U.S.C. § 1344 (2006).

188. CLEAN WATER ACT SECTION 404(Q) MEMORANDUM OF AGREEMENT BETWEEN THE ENVIRONMENTAL PROTECTION AGENCY AND THE DEPARTMENT OF THE ARMY (Aug. 11, 1992), <http://water.epa.gov/lawsregs/guidance/wetlands/dispmoa.cfm>.

189. *Id.* at 1.

190. See 33 C.F.R. § 330.4(f) (2010) (“No activity is authorized by any [nationwide permit] if that activity is likely to jeopardize the continued existence of a threatened or endangered species as listed or proposed for listing under the Federal Endangered Species Act (ESA), or to destroy or adversely modify the critical habitat of such species.”); 40 C.F.R. § 230.10(b) (3) (2010) (“No discharge permit shall be issued if it . . . [j]eopardizes the continued existence of species listed as endangered or threatened under the Endangered Species Act of 1973, as amended, or results in likelihood of the destruction or adverse modification [of designated critical habitat].”). In addition, Army Corps Regulatory Guidance Letter (RGL) 88-12, extended by RGL 05-06, specifies that the Corps will not consider a Section 404 permit application that does not comply with the ESA. See Regulatory Guidance Letter 88-12 of the United States Army Corps of Engineers (Sept. 9, 1988), available at <http://www.usace.army.mil/CECW/Documents/cecwo/reg/rgls/rgl88-12.pdf>; see also Regulatory Guidance Letter 05-06 of the United States Corps of Engineers (Dec. 7, 2005), available at <http://www.usace.army.mil/CECW/Documents/cecwo/reg/rgls/rgl05-06.pdf>.

Regulatory Guidance Letters, though influential, are not mandatory guidance for the Corps’ district offices, and are not legally binding. See *Nw. Bypass Grp. v. U.S. Army*

General and nationwide¹⁹¹ permits under Section 404 pose a slightly different problem, effectively exempting individual projects from the normal review process. These permits are blanket, preemptive approvals for classes of projects that the Corps expects to have minimal impact on wetlands. In the case of dredge-and-fill operations that would impact listed species, however, permittees must go through ESA Section 7 consultation even if a nationwide permit would otherwise grant a CWA Section 404 permit to allow the proposed project.¹⁹² Furthermore, the Army Corps has recognized that it must go through Section 7 consultation with FWS and NMFS before issuing the nationwide permits themselves.¹⁹³ As a result, even nationwide permits from the Army Corps do not offer a means of avoiding the ESA's Section 7 and Section 9 protections for listed species.

The four currently-listed species of marine invertebrates occupy nearshore habitats near dense coastal human activity: California in the case of the abalone species, and southern Florida in the case of the corals. Many coastal development projects are likely to require dredge-and-fill permits. Other tidal wetland habitats, including estuaries and bays, are hugely important resources for many marine species that may become candidates for ESA protection in the future. Because the Army Corps is bound by the ESA in granting dredge-and-fill permits, listed invertebrates with habitat in the nearshore marine environment could effectively stop many projects requiring these permits.¹⁹⁴

These Section 7 consultation requirements surrounding marine invertebrates highlight a necessary shift from thinking about clearly-

Corps of Eng'rs, 470 F. Supp. 2d 30, 51 (D.N.H. 2007) ("RGLs are 'issued without notice and comment and do not purport to change or interpret the regulations applicable to the Section 404 program . . . [and] are not binding, either upon permit applicants or Corps District Engineers.'" (quoting *Envtl. Def. v. U. S. Army Corps of Eng'rs*, No. 04-1575(JR), 2006 WL 1992626, at *7 (D.D.C. July 14, 2006))); *see also* *Hobbs v. United States*, 947 F.2d 941, 1991 WL 230202, *4-5 (4th Cir.1991) (concluding that the EPA's wetland delineation manuals are interpretive guidance documents without the force of law).

191. 33 C.F.R. § 330.1 (nationwide permits go through a public notice-and-comment period before approval).

192. Reissuance of Nationwide Permits, 72 Fed. Reg. 11,092, 11,159 (Mar. 12, 2007).

193. *Id.* at 11,096 ("In the September 26, 2006, Federal Register notice, we stated that we will conduct Endangered Species Act Section 7(a)(2) consultation for the NWP's [nationwide permits]. . . . Prior to the effective date of these NWP's, the Corps will issue a section 7(d) determination for the NWP Program.").

194. Because the legal force of Regulatory Guidance Letters is uncertain, *see* *Nw. Grp. v. U.S. Army Corps of Eng'rs*, 552 F. Supp. 2d 97, 120 (D.N.H. 2008) (RGLs are not binding); *Salt Pond Assoc. v. U.S. Army Corps of Eng'rs*, 815 F. Supp. 766, 780-81 (D. Del. 1993) (holding RGLs do not change substantive rules of law), and in any event the statutory language of the ESA and its associated regulations would trump a contrary Army Corps Guidance Letter, future guidance from the Corps is not likely to avoid any project's conflict with the ESA.

identifiable and individual harms to listed species, to a view of diffuse and probabilistic harms. Whether or not water itself is included as the species' critical habitat, degradation in water quality threatens not only the species' habitat but the survival of individual animals as well. Leveraging the modeling and monitoring technology discussed above and in part III offers a way to make Section 7 consultation less onerous on the agencies and simultaneously more effective at avoiding harm to listed species. Although the number of required consultations will surely rise with an increased number of protected marine species, and the overlaps with Clean Water Act provision make these consultations somewhat more complicated, developing and routinely ground-truthing models of species' distribution, dispersal, and abundance would go a long way towards streamlining the consultation process.

V. HOW DOES THE PRESENCE OF LARVAE AND JUVENILES IMPACT THE DESIGNATION OF CRITICAL HABITAT? IS THAT HABITAT OCCUPIED IF LARVAE ARE FOUND IN IT SEASONALLY OR OCCASIONALLY?

In designating the critical habitat of protected species, the agency must specify habitat features essential to the conservation of the species, known as Primary Constituent Elements.¹⁹⁵ Because "conservation" here refers not just to species maintenance but also recovery,¹⁹⁶ citizen suits can force the agency to include those habitat elements necessary for the recovery of the species, even if they are unnecessary for its mere survival. In practice, NMFS already evaluates Primary Constituent Elements for salmonid larvae and juveniles, highlighting the unique requirements of these early life stages.¹⁹⁷

195. 50 C.F.R. § 424.12 ("When considering the designation of critical habitat, the Secretary shall focus on the principal biological or physical constituent elements within the defined area that are essential to the conservation of the species. Known primary constituent elements shall be listed with the critical habitat description. Primary constituent elements may include, but are not limited to, the following: roost sites, nesting grounds, spawning sites, feeding sites, seasonal wetland or dryland, water quality or quantity, host species or plant pollinator, geological formation, vegetation type, tide, and specific soil types."). See also *Ariz. Cattle Growers Ass'n v. Kempthorne*, 534 F. Supp. 2d 1013, 1021-22 (D. Ariz. 2008) (discussing the requirement for primary constituent elements in habitat designation in upholding FWS's habitat designation for the Mexican Spotted Owl); *Home Builders Ass'n v. U.S. Fish & Wildlife Serv.*, 268 F. Supp. 2d 1197, 1211-13 (E.D. Cal. 2003) (vacating critical habitat designation for the Alameda Whipsnake for want of sufficient description of the habitat's primary constituent elements).

196. 16 U.S.C. § 1532 (2006) defines "conservation" as methods necessary to bring the listed species to a point where it no longer needs protection; see also 50 C.F.R. 424.02(c) (same).

197. See DELTA SMELT BIOP, *supra* note 97, at 240 (listing PCEs for spawning and larval/juvenile transport).

One practical effect of designating critical habitat is that, under Section 7, other federal agencies must consult with the listing agency before undertaking any action that would adversely modify the primary constituent elements of a listed species' critical habitat.¹⁹⁸ Critical habitat in the nearshore marine environment therefore has the potential to trigger consultation for a broad swath of federal actions such as dredging and filling,¹⁹⁹ licensing for commercial fishing,²⁰⁰ issuing Clean Water Act discharge permits,²⁰¹ permitting extraction of offshore petroleum or mineral reserves,²⁰² licensing power plants that intake coastal water,²⁰³ and any federally-funded construction that impacts the coastal ocean and may significantly harm designated critical habitat. Adversely modifying critical habitat can also trigger the ESA's Section 9 provisions prohibiting take of listed species,²⁰⁴ discussed above in part III. Clearly, how the listing agencies define critical habitat for imperiled species could hugely impact federal activities along the coasts.²⁰⁵

198. 16 U.S.C. § 1536(a)(2). The other effect of Section 7 consultation is that agencies must ensure they do not jeopardize the existence of a listed species. Section 7 is discussed elsewhere in this paper.

199. Dredge and fill is regulated by Section 404 of the Clean Water Act, 33 U.S.C. § 1344 (2006). Clearly, any dredge or fill operations in the vicinity of listed nearshore species have the potential to cause harm to the species and their critical habitat.

200. *See Strahan v. Coxe*, 127 F.3d 155 (1st Cir. 1997) (upholding the District court's ruling requiring the State of Massachusetts to apply for an Incidental Take Permit under the ESA before issuing commercial fishing licenses, as fishing practices caused harm to listed Northern Right Whales).

201. The National Pollution Discharge Elimination System (NPDES), 33 U.S.C. § 1342, regulates point sources of water pollution. Such point sources can, and likely do, impact listed marine species, but because most states administer their own NPDES permitting systems, the federal government has limited authority to require Section 7 consultation associated with permitting. *See Am. Forest & Paper Ass'n v. U.S. Envtl. Prot. Agency*, 137 F.3d 291, 294 (5th Cir. 1998). However, as discussed below, the EPA still administers the NPDES program for some critical U.S. territories, for which permits would be subject to ESA Section 7 consultation.

202. The U.S. Department of the Interior's Bureau of Ocean Energy Management, Regulation, and Enforcement—formerly the Minerals Management Service—controls oil and gas leases more than three miles offshore, under the Outer Continental Shelf Lands Act of 1953, 43 U.S.C. § 1331 (2006); *see also* Federal Oil & Gas Royalty Management Act of 1982, 30 U.S.C. § 1701 (2006). Natural resources extraction is likely to impact listed species, and therefore requires ESA Section 7 consultation.

203. Flow-through cooling water, which many power plants use, is also regulated by the Clean Water Act; *see* 33 U.S.C. § 1342.

204. *Babbitt v. Sweet Home Chapter, Cmty. for Great Or.*, 515 U.S. 687, 708-09(1995) (O'Connor, J., concurring) (The Court held and Justice O'Connor concurred that adverse modification of critical habitat can be 'take' under Section 9 if it causes actual harm.).

205. Note, too, that these same coastal areas are home to some of the densest development and highest property values in the US. and consequently they have experienced intense environmental degradation already. This makes conserving critical habitat for threatened and endangered species all the more politically challenging.

A. *Critical Habitat for Marine Species, and Marine Invertebrates in Particular*

Critical habitat for listed vertebrates, such as marine mammal species, has not generated much controversy.²⁰⁶ But invertebrates pose a different challenge, again because of the animals' biology: species' habitat requirements are often totally different during different life stages. Invertebrate larvae also highlight a key distinction between terrestrial and marine habitat that is often overlooked: whereas species' habitat on land occupies a two-dimensional area, marine species live in a three-dimensional volume. Adult corals, for example, require submerged but shallow areas with hard substrate on which to grow, while coral larvae require open water through which to disperse.²⁰⁷ A critical habitat designation effective across the corals' entire life cycles, therefore, would include not just the submarine substrate where adult corals are likely to occur, but also the volume of water through which the larvae are likely to travel.²⁰⁸ The existing and proposed critical habitat designations for the Leatherback Turtle, for example, both explicitly include the ocean water itself, through which the turtles necessarily must swim.²⁰⁹

The agencies' interpretive guidelines require that the designating agency consider such factors as "sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal."²¹⁰ While "germination" and "seed dispersal" appear to apply specifically to plants in this context, they express the breadth and aim of the habitat requirements the rules cover. In the context of marine invertebrates, then, the agency must consider habitat necessary for the fertilization and dispersal of animal larval forms, integral to "breeding" and "reproduction" and precisely analogous to "seed dispersal." Moreover, the guidelines' criteria are not

206. *But see* Strahan v Coxe, 127 F.3d 155 (1st Cir. 1997); Natural Res. Def. Council v. Evans, 279 F. Supp. 2d 1129, 1177 (N.D. Cal. 2003) (challenging Navy operations in the Pacific that might impact the designated critical habitat of listed marine mammals).

207. These habitat characteristics are merely illustrative. *See* Critical Habitat for Threatened Elkhorn and Staghorn Corals, 73 Fed. Reg. 72,210, 72,214 (Nov. 26, 2008) (codified at 50 C.F.R. pt. 223, 226), for the actual (very brief) coral habitat designation, as well as the coral habitat Primary Constituent Elements, discussed *infra*.

208. A closely related question, discussed *infra* Part IV, is whether adverse habitat modification includes modifying or polluting the ocean "upstream" of the designated habitat substrate.

209. The proposed turtle habitat's PCEs include avenues of passage free from permanent structures, as well as the presence of prey species such as jellyfish. The agency considered and rejected the idea of including water quality as a PCE both because of a purported lack of data and because the prey species may adequately reflect water quality. *See* Determination of Critical Habitat for Leatherback Sea Turtle, 44 Fed. Reg. 17,710, 17,710 (Mar. 23, 1979); Proposed Rule to Revise the Critical Habitat Designation for the Endangered Leatherback Sea Turtle, 75 Fed. Reg. 319 (Jan. 5, 2010).

210. 50 C.F.R. § 424.12(b) (2010).

exhaustive, and the agencies are free to consider other factors that are essential to a given species.²¹¹

Because at present the critical habitat does not clearly include the water itself in addition to the substrate, it is not obvious whether the only existing designated critical habitat for marine invertebrate species meets the statutory and regulatory criteria.

1. Existing Designated Critical Habitat for Coral Species, and the Lack Thereof for Abalone

NMFS designated critical habitat for the two threatened coral species in 2008.²¹² In doing so, the agency identified the physical feature essential to the species' conservation as "*substrate* of suitable quality and availability to support larval *settlement* and *recruitment*."²¹³ Using the word "substrate" suggests that only the sea floor, and not the water itself, is included in the critical habitat.²¹⁴ "Settlement" and "recruitment" are similarly life history milestones that occur on the sea floor rather than suspended in the water column. These terms, coupled with ambiguous language in the rest of the regulation, leave in doubt whether the coral species' critical habitat includes the open water above such substrate.

An informatively analogous set of species, the freshwater mussels, receives different treatment. FWS includes sufficient water flow and water quality as primary constituent elements of the mussels' critical habitats, indicating that the habitat is not merely the substrate but also the water above that substrate.²¹⁵ By contrast, NMFS explicitly rejected a comment that would have included sufficient water quality and temperature as elements of the corals' critical habitat.²¹⁶ The agency considered these elements redundant, reasoning that suitable substrate

211. *Id.*

212. Critical Habitat for Threatened Elkhorn and Staghorn Corals, 73 Fed. Reg. at 72,210.

213. 50 C.F.R. § 226.216(a) (emphasis added).

214. The Final Rule defines "substrate of suitable quality" as "consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover," further emphasizing the idea that the designated "substrate" does not include the water above it. *See* Critical Habitat for Threatened Elkhorn and Staghorn Corals, 73 Fed. Reg. at 72,214.

215. Designation of Critical Habitat for Five Endangered Mussels in the Tennessee and Cumberland River Basins, 69 Fed. Reg. 53,136, 53,136 (Aug 31, 2004) (codified at 50 C.F.R. pt. 17); *see also* Advanced Notice of Proposed Rulemaking to Designate Critical Habitat for Cook Inlet Beluga Whales, 74 Fed. Reg. 17,131, 17,131 (Apr. 14, 2009) (codified at 50 C.F.R. pt. 226) (proposing critical habitat for Beluga whales also necessarily includes the water, as that species only occupies the water itself, and not the substrate).

216. Critical Habitat for Threatened Elkhorn and Staghorn Corals, 73 Fed. Reg. at 72,214.

would reflect water of sufficient quality.²¹⁷ As a result, the agency has not yet wrestled with the tricky issues that arise when a transient volume of ocean water might be protected habitat.²¹⁸

NMFS has yet to designate habitat for the other two listed marine invertebrate species, the abalones. In the case of the white abalone, the agency determined that it was not prudent to designate critical habitat.²¹⁹ For the black abalone, NMFS first found that critical habitat was not yet determinable,²²⁰ and has only just recently issued a notice proposing particular habitat to be designated as critical.²²¹ The protections for these two species are consequently incomplete. Moreover, it remains unclear how the agency will balance the competing biological, environmental, and economic factors in delineating critical habitat, and what the regulatory impact of that designation might be. Abalone species have life cycles similar to those of the corals, with similar planktonic larval periods,²²² and so share the difficulties inherent in designating habitat for these mercurial animals.

B. Better Accommodating Invertebrates' Life Cycles in Designating Critical Habitat

Whether habitat is occupied is not dispositive in designating that habitat as critical: the agencies may designate unoccupied or occupied habitat, and, as noted above, even occupied habitat is often not

217. *Id.* (agency apparently not responding to the comments' temperature concern).

218. The agency similarly avoided designating water quality as a PCE when proposing critical habitat for the leatherback turtle. *See* Proposed Rule to Revise the Critical Habitat Designation for the Endangered Leatherback Sea Turtle, 75 Fed. Reg. 319, 319 (Jan. 5, 2010) (codified at 50 C.F.R. pt. 226).

219. Endangered Status for White Abalone, 66 Fed. Reg. 29,046, 29,048-49 (May 29, 2001) (codified at 50 C.F.R. pt. 224).

220. Endangered Status for Black Abalone, 74 Fed. Reg. 1,937, 1,945 (Jan. 14, 2009) (codified at 50 C.F.R. pt. 224).

221. The proposed critical habitat includes water quality as a Primary Constituent Element which may provide a degree of protection to the abalone's larval forms. However, because the critical habitat (as proposed) only includes the rocky intertidal substrate from Mean Higher High Water to 6 meters depth, it does not encompass most of the open water larval habitat. Finally, the summary of activities that may affect the critical habitat's Primary Constituent Elements does include several actions that could negatively impact the abalone larvae, such as the operation of desalination or power plants and the discharge of non-point source pollution. Several of these entries explicitly acknowledge the effects of specified activities on the larval stages (as distinct from the adults) of the species. Proposed Rulemaking to Provide Habitat for Black Abalone, 75 Fed. Reg. 59,900, 59,904-05, 59,910-18 (Sept. 28, 2010) (codified at 50 C.F.R. pt. 226).

222. *Compare* Endangered Status for White Abalone, 66 Fed. Reg. at 29,047 (white abalone larval period 5 to 14 days), *with* Raphael Ritson-Williams et al., *Larval Settlement Preferences and Post-Settlement Survival of the Threatened Caribbean Corals *Acropora palmata* and *A. cervicornis**, 29 CORAL REEFS 71, 71 (2010) (corals competent to metamorphose at 5 and 7 days).

designated as critical.²²³ As a practical matter, however, the listing agency is much more likely to designate already-occupied habitat as critical.²²⁴ Therefore a threshold conceptual issue might be whether a given patch of water is “occupied” if a species’ larvae or juveniles are found there: if a habitat could be considered occupied, it would likely be politically easier for the agency to designate it for protection.

By definition, larvae and juveniles are transient forms, short-lived phases on the path to an adult form. In the case of many species, these immature forms are the primary means of dispersal and genetic exchange between populations.²²⁵ As a result many species’ larvae are transported widely by ocean currents and occur only at low densities in a given volume of water. Precisely these same properties make them difficult cases under the ESA: rather than definitively occupying habitat, such as a bald eagle might, marine larvae exist in a given volume of ocean water probabilistically. Whether larvae occur in a particular place at a particular time is a function of the overall abundance of that species’ larvae, and the spatial or temporal variance in that abundance.

| | | Variance in Larval Abundance | |
|--------------------------|------|---|--|
| | | High | Low |
| Overall Larval Abundance | High | Spatial or temporal patchiness in high-fecundity species | Predictable or uniform larval production in high-fecundity species |
| | Low | Spatial or temporal patchiness in low-fecundity species; outlying individuals of higher-fecundity species | Predictable, low-fecundity species |

Table 1: Abundance and spatial/temporal variance as two major conceptual axes in determining whether a species’ larvae “occupies” a habitat.

223. See 12-month Determination on How to Proceed with a Petition to Revise Designated Critical Habitat for Elkhorn and Staghorn Coral, 75 Fed. Reg. 3,711, 3,711 (Jan. 22, 2010).

224. See *Cape Hatteras Access Pres. Alliance v. U.S. Dep’t of the Interior*, 344 F. Supp. 2d 108, 125 (D.D.C. 2004) (noting that “[d]esignation of unoccupied land is a more extraordinary event than designation of occupied lands”).

225. See, e.g., Ryan P. Kelly & Stephen R. Palumbi, *Genetic Structure Among 50 Species of the Northeastern Pacific Rocky Intertidal Community*, 5 PLOS ONE e8594 (2010), <http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0008594> (analyzing the different levels of population connectivity among species with different life history traits).

Table 1 provides a useful framework for thinking about whether a species' larvae "occupies" a particular volume of water as its habitat.²²⁶ As a normative starting point, it would make sense that the more likely a species' larvae is to be found in a given volume of water, the more likely that volume of water should be designated critical habitat. But such a sliding-scale must be calibrated for each particular species; low-fecundity species are perhaps more likely to be endangered, and it would be nonsensical to eliminate habitat from being designated as critical merely because such a species only occurs there at low density.²²⁷ After all, low and declining population numbers is a primary motivation for ESA protections in the first place.

The top-right quadrant of Table 1—waters with predictably high abundances of a listed species' larvae—are the easiest case, analogous to habitat that terrestrial species occupy. This is water in which one can often find the listed species, and thus it is "occupied." The bottom-left quadrant, by contrast, is the hardest case: it seems the least likely to be designated as "occupied." On occasion, however, this water has high densities of low-fecundity species' larvae, probably an important conservation target. Although designating critical habitat is ultimately a policy decision in which larval abundance and variance should weigh as factors, it is important to note that higher- and lower-fecundity species will demand different standards for determining whether their larvae "occupy" a particular volume of habitat.

Habitat need not be occupied continuously, or at all, to be designated as critical. Most relevantly, those areas of habitat that "support *one or more life stages*" may be protected, including sites for "incubation and larval development."²²⁸ The present ESA regulations, therefore, do not bar NMFS from designating critical habitat that includes the water above the substrate merely because the adults of the

226. This framework ties easily into the modeling and monitoring efforts discussed supra in the context of take and jeopardy analyses.

227. If high densities were required for critical habitat, surely the vast majority of listed species, including the California Condor and the Northern Spotted Owl, would lack designated critical habitat.

228. Designation of Critical Habitat for 12 Evolutionary Significant Units of West Coast Salmon and Steelhead in Washington, Oregon, and Idaho, 70 Fed. Reg. 52,630, 52,684 (September 2, 2005) (codified at 50 C.F.R. pt. 226) (designating habitat for salmon and steelhead in western states; these species generally occupy the rivers and streams designated as critical habitat while they are larvae or juveniles, and again to reproduce as adults) (emphasis added); see also 50 C.F.R. § 226.214 (2010) (Primary Constituent Elements for Gulf Sturgeon which explicitly include requirements for eggs and larvae, as well as pathways for migration); 50 C.F.R. § 226.211-212 (PCEs for various other listed salmon). Other highly migratory species, such as Right whales, various sea turtles, and birds including Steller's eider, similarly only occupy particular habitat seasonally.

listed species do not occupy that habitat. Instead, the regulations would seem to require that the water be included because it is quite literally essential for the species' conservation, survival, and recovery.²²⁹ Just as in the case of the leatherback turtle, where the existing and proposed critical habitat includes the volume of water in which the species spends much of its life, the ocean water itself—in which the invertebrates spend their lives and through which their larval and juvenile stages must travel—is clearly a “principle biological or physical constituent element[]”²³⁰ of the listed species' habitat. It borders on irrational to exclude from designation the volume of seawater in which invertebrates must exist.

An open question worth exploring is whether habitat may be designated as critical only intermittently—for example, seasonally or only during breeding periods—or even whether mobile designated habitat is permissible. If temporal flexibility were feasible, it would likely make designating critical habitat for larvae more politically palatable. Similarly, designating critical habitat that moved along with the protected species could minimize the political fallout that would attend, say, designating the entire California coast as critical black abalone habitat.

While the FWS/NMFS Joint Regulations that govern critical habitat designation bar the use of “ephemeral” reference points for defining critical habitat,²³¹ they do not appear to bar temporary or intermittent critical habitat designation. The boundaries of critical habitat can be dynamic if long-lasting (i.e., not ephemeral),²³² and it would seem technically feasible to overcome the notice problems that a spatially and temporally dynamic designation would cause. In the simplest case, NMFS could establish Summer and Winter critical habitat that tracked the locations of adults and larvae, and publish a schedule of habitat designations in the Federal Register, broadcasting seasonal designations via standard media and GPS as the relevant dates approached.²³³ This

229. 50 C.F.R. §§ 424.02(d), 424.12(b).

230. *Id.* § 424.12(b).

231. *Id.* § 424.12(c).

232. *Cape Hatteras Access Pres. Alliance v. U.S. Dep't of the Interior*, 344 F.Supp.2d 108, 126 (D.D.C. 2004) (holding that FWS was reasonable in using “movable yet long-lasting lines, such as the [mean lower low-water] and vegetation lines” as boundaries for piping plover habitat, and noting “‘ephemeral’ appears to be unconcerned with whether the ephemeral thing moves or is fixed in place, but whether the thing exists for a long or short period of time”).

233. Note that a District court struck down a ‘zonal’ approach to designated critical habitat, because the zones were not rationally related to the data presented. In that case the zones were defined on the basis of conservation value rather than being defined temporally. *See Greenpeace v. Nat'l Marine Fisheries Serv.*, 237 F. Supp. 2d 1181, 1199 (W.D. Wash. 2002).

would mainly impact federal agencies,²³⁴ which would perhaps be more on notice than private citizens.

VI. DISCUSSION AND CONCLUSIONS

Marine invertebrates at first appear to be an uneasy fit into the existing statutory framework of the ESA, particularly with respect to their small and widely-dispersed larvae. This creates the potential for under-enforcement and a failure of the ESA as applied to these species, or conversely, widespread interference with vested coastal interests and economic activity. However, it is both possible and necessary that the provisions of the ESA apply to imperiled animal species beyond the charismatic megafauna that fit most easily into the Act's terms. Large vertebrates are merely the most recognizable cases of biodiversity in crisis; the other ninety nine percent of animal species are by many measures more worthy of protection. If the ESA is going to stem biodiversity's bleeding, it must apply more broadly. The case of marine invertebrates illustrates some of the challenges the Act faces when confronted with animals of more diverse and complex life histories.

A. *Political Implications of Pervasive and Protected Larvae*

It may be tempting to use the threat of severe economic impact along the coasts as leverage in Congress to improve the ESA, especially because the coastal regions include the nation's most expensive real estate and highest-density areas. This could involve bargaining away some protections for nearly-invisible larvae in exchange for greater gains elsewhere. Similar showdowns resulted in the National Forest Management Act, the Clean Water Act, and the Federal Land Policy and Management Act.²³⁵ But such a bargain seems unwise, risking losing the support of the public when it is more prudent (and likely more effective) simply to tailor the regulatory repercussions of listing species to the biology of the species themselves. Rather than a chance to change the ESA, the impending increase in the number of protected marine invertebrates better represents an opportunity to test the law's protections of distinctly uncharismatic species. Only if the Act will not stretch to cover the necessary diversity of life forms will it be wiser to view difficult cases as bargaining chips rather than as the very things the law was meant to protect in the first place.

234. Through the Section 7 consultation process. *See infra* Part IV.

235. For a review of the cases and the political environments that led to these laws, see Oliver A. Houck, *The Water, The Trees, and the Land: Three Nearly Forgotten Cases that Changed the American Landscape*, 70 TUL. L. REV. 2279 (1996).

Instead, the agency and the relevant interest groups should use the leverage marine invertebrates provide to achieve conservation goals while simultaneously collecting better information about the multiple competing uses of the coastal oceans. It seems clear that through a combination of careful modeling and monitoring, tailored regulations, and synoptic threat analysis, it is possible to avoid the ESA's invertebrate paradox. Reasonable enforcement actions and the possibility of ecosystem-level management, perhaps in part through an HCP, might allow the NMFS to fund the data collection that would simultaneously help listed marine species recover and help to avoid imperiling other species in the future.

B. The Diffuse Causation Problem and the Climate Change Analogy

Thinking of harm to endangered species as probabilistic, rather than discrete and identifiable, is a considerable hurdle, though the analogies to torts and nuisance²³⁶ provide useful lessons for this almost postmodern view of biodiversity protections. Such a view is bound to become more relevant in light of the many subtle causes of climate change, and the threat to listed species that such a profound ecosystem shift portends. Liability for this kind of diffuse harm in part motivated the Bush administration's proposed changes to the ESA's Section 7 regulations, which would have narrowed the scope of the causation inquiry subject to consultation.²³⁷

Listed marine invertebrates simply move the debate over an amorphous future harm into the realm of more immediate harm to our marine species, making the same question more concrete: what is a negligible harm to a protected species or its habitat? NMFS must grapple with this question in applying both Sections 7 and 9, especially with respect to the species' larvae, which are tiny and occurring with varying probability over vast volumes of ocean water. In this context, it becomes increasingly important to ensure that the existing harm-causation inquiries remain as broad as is reasonable to fulfill the ESA's statutory goal of helping the species recover until the law's protection is no longer necessary.

C. Lessons from Analogous Fish Examples

The analogous fish, e.g., listed species of salmonids and the Delta Smelt, are of limited help in divining the future of listed marine

236. See *supra* Part IV.A.

237. See Interagency Cooperation Under the Endangered Species Act, 73 Fed. Reg. 47,868, 47,869 (Aug. 15, 2008).

invertebrates. While the fishes have well-defined spawning areas in heavily-managed rivers, reproduction in marine species takes place over vast spatial scales in the far-less-regulated ocean. However, a similar array of threats faces the tiny larval phase of listed marine species as faces the rivers' fish larvae. The overlap between ESA and water quality protections is particularly instructive: Delta Smelt and salmonid fry are heavily impacted by toxins and agricultural runoff into river waters.²³⁸ These same terrestrial pollutants threaten listed marine species, and perhaps similar measures, such as use buffer-zones between the critical aquatic habitat and surrounding land, could work for marine species.²³⁹ Development buffer zones seem particularly apt in the case of listed coral species, which have suffered as their required water clarity has declined due to sediments and eutrophication accompanying coastal development.²⁴⁰

A main source of mortality for fish fry is entrainment by large-scale water users such as power plants, expected to be a similar threat to marine larvae and juveniles. The entrainment limits and extensive monitoring that Section 7 ITPs have for listed salmonids and the Delta Smelt²⁴¹ will likely be appropriate for marine species as well, and will be made more efficient by marine modeling efforts that incorporate a substantial amount of biological information about the modeled species.

Finally, the political lessons from analogous fish species are perhaps the most important. Ultimately, biodiversity management is people management. When the complexities of ecosystem interactions get simplified for cable news-entertainment, environmental protection is bound to lose.²⁴² Allowing the ESA's opponents to frame a species listing as pitting American jobs and security against the rights of larvae would very clearly result in a defeat for biodiversity protection. Instead, it is important to properly frame marine conservation as a global, ecosystem-level problem. We depend on the ocean for a vast array of

238. See *Natural Res. Def. Council v. Kempthorne*, 506 F. Supp. 2d 322, 335 (E.D. Cal. 2007) (citing agency BiOp for sources of reduced water quality).

239. See *Wash. Toxics Coal. v. U.S. Evtl. Prot. Agency*, 413 F.3d 1024, 1029 (9th Cir. 2005) (upholding a District Court's injunction that required pesticide-free buffer zones around endangered salmonid stream habitat).

240. See, e.g., Terence P. Hughes, et al., *Algal Blooms on Coral Reefs: What are the Causes?* 44 *LIMNOLOGY & OCEANOGRAPHY* 1583 (1999); Terence P. Hughes, *Catastrophic Phase Shifts and Large-Scale Degradation of a Caribbean Coral Reef*, 265 *SCI.* 1547 (1994); Brian E. Lapointe & Mark W. Clark, *Nutrient Inputs from the Watershed and Coastal Eutrophication in the Florida Keys*, 15 *ESTUARIES* 465 (1992).

241. See, e.g., COLUMBIA RIVER CONSULTATION, *supra* note 135, at 14-5.

242. See, e.g., Hannity, *The Valley Hope Forgot: California Farmers at Obama's Mercy* (Fox News television broadcast Sept. 18, 2009), transcript available at <http://www.foxnews.com/story/0,2933,552081,00.html> ("But they have all this water that they are sending to the ocean rather to the farms because of this little delta smelt.").

services, products, and jobs. Keeping that ecosystem intact is a priority that people across the political spectrum should be able to agree upon.

