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# SMALL POPULATIONS IN JEOPARDY: A DELTA SMELT CASE STUDY

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Under §7 of the federal Endangered Species Act (ESA or the Act),[1] federal agencies must ensure that actions they authorize, fund, or carry out are "not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species."[2] For species with low and declining populations, applying this standard is legally and scientifically difficult.[3] The U.S. Fish and Wildlife Service (FWS) faced this problem in its recent biological opinion (BiOp) analyzing impacts to threatened Delta smelt from water project operations in the California Delta. FWS concluded the "species' recent abundance trends strongly suggest it is in the midst of demographic collapse,"[4] and most recent surveys to locate smelt have failed to find them.[5] Nevertheless, FWS approved agency actions that will likely increase extinction risk for Delta smelt.

This Comment illustrates, through a case study of the Delta smelt BiOp, the difficulties in making ESA jeopardy determinations for species on the brink of extinction. We conclude that the myriad challenges inherent in conservation of some small and declining populations make reasoned §7 analysis difficult, bordering on impossible.

## I. ESA Framework

The ESA protects species listed as threatened or endangered by FWS or the National Marine Fisheries Service (NMFS) (together, the Services).[6] When species are listed, FWS or NMFS designates the habitat critical for the species' survival or recovery (critical habitat). The listed species are generally protected from "take" under §9 of the Act.[7]

Section 7 places special obligations on federal agencies. To meet its §7 no-jeopardy and no-adverse-modification obligations,[8] an agency undertaking an action that may affect a listed species consults with the relevant expert agency (FWS or NMFS). Formal §7 consultations generally culminate with the expert agency issuing a BiOp address-

1. 16 U.S.C. §§1531-1544, ELR Stat. ESA §§2-18.
2. ESA §7, 16 U.S.C. §1536.
3. *See* Steven P. Quarles & Thomas R. Lundquist, *The Pronounced Presence and Insistent Issues of the ESA*, 16 Nat. Resources & Env't 59, 60 (2001):

> [A]ny species that are sufficiently at risk to be considered threatened or endangered under the ESA have very small populations. This fundamental fact can make the task of collecting adequate, useful, timely and reliable information about these species almost insuperable. . . . The level of knowledge about a listed species is all too frequently insufficient to permit truly confident consideration—or ultimate approval—of less costly and disruptive alternatives to secure the species' protection.

Eric Biber, *The Application of the Endangered Species Act to the Protection of Freshwater Mussels: A Case Study*, 32 Envtl. L. 91, 111 (2002) (discussing challenges to recovery resulting from small population sizes).

4. FWS, Biological Opinion for the Reinitiation of Consultation on the Coordinated Operations of the Central Valley Project and the State Water Project 172 (2019) [hereinafter 2019 FWS BiOp], https://www.fws.gov/sfbayDelta/cvp-swp/documents/10182019_ROC_BO_final.pdf.
5. Memorandum from James White, Environmental Scientist, Bay Delta Region, to Gregg Erickson, Regional Manager, Bay Delta Region (Jan. 13, 2020), https://nrm.dfg.ca.gov/FileHandler.ashx?DocumentId=175813&inline.
6. 16 U.S.C. §1533(b)(1)(A).
7. *Id.* §1538(a)(1)(B). The Act defines "take" as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct," *id.* §1532(19). Regulations expand this definition to "include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering." 50 C.F.R. §17.3 (2006); *see* Babbitt v. Sweet Home Chapter of Cmtys. for a Great Or., 515 U.S. 687, 715, 25 ELR 21194 (1995). Protection for threatened species is limited to what NMFS or FWS "deems necessary and advisable to provide for the conservation of such species." 16 U.S.C. §1533(d).
8. 16 U.S.C. §1536:

> Each Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded, or carried out by such agency . . . is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of [critical] habitat of such species.

ing "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 action, and the cumulative effects of the proposed action."[9] If the expert agency determines the action will not violate §7, or that a "reasonable and prudent alternative" (RPA) to the agency action will not violate §7, the agency issues an incidental take statement to exempt the action or RPA from §9's taking prohibition, contingent on the action agency's implementation of any required mitigation measures.[10]

Under §7, the expert agency must determine the proposed federal action is likely to "jeopardize the continued existence" of a listed species if an action appreciably reduces the likelihood of *either* survival *or* recovery of the listed species.[11] When few individuals of a species remain and the species is in steep decline, a condition sometimes termed "baseline jeopardy," any negative impact seems likely to further jeopardize the species' continued existence. Courts have largely adopted that reading of the statute, although the Services continue to resist this interpretation.

In a 2008 decision, the U.S. Court of Appeals for the Ninth Circuit held that "where baseline conditions already jeopardize a species, an agency may not take action that deepens the jeopardy by causing additional harm"[12]; the U.S. Court of Appeals for the District of Columbia (D.C.) Circuit endorsed this approach in 2018.[13] Further, where critical habitat is "already severely degraded," the Ninth Circuit requires that "the agency know roughly at what point survival and recovery will be placed at risk before it may conclude that no harm will result from 'significant' impairments to habitat."[14] The agency must provide a "tipping point," beyond which jeopardy will occur.[15] Even in this context, however, "an agency only 'jeopardize[s]' a species if it causes some new jeopardy."[16]

Although new federal regulations seek to change this standard and eliminate the concept of baseline jeopardy,[17] at present, agency actions must at worst do no harm to small, declining populations, lest they jeopardize the species and violate the ESA.[18] Many BiOps approve agency actions with known negative impacts, but offset those impacts with mitigation actions. To approve a BiOp for such an action affecting small, declining populations, the expert agency must find that these mitigation actions will successfully offset the negative impacts.

Courts review ESA decisions under the Administrative Procedure Act (APA). "Under the APA, an agency action is valid unless it is arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law."[19]

## II. Delta Smelt

The Delta smelt is a small, federally listed as "threatened" fish that lives only in the San Francisco Estuary (SFE). The smelt generally resides in the upper estuary and especially the California Delta. FWS listed the smelt as a threatened species in 1993, after a 90% decline in abundance over a 20-year period.[20] Its protection has been controversial ever since.

Like many listed species, the Delta smelt faces a fundamental problem: the habitat where the species evolved no longer exists. Humans have irrevocably altered the water flows, fluvial geomorphology,[21] and biological interactions that constituted the historical California Delta. Much of the water that once flowed through the estuary is stored or

9. Gifford Pinchot Task Force v. U.S. Fish & Wildlife Serv., 378 F.3d 1059, 1063, 34 ELR 20068 (9th Cir. 2004), *amended*, 387 F.3d 968 (9th Cir. 2004).
10. *See* 16 U.S.C. §1536(b)(4), (g).
11. National Wildlife Fed'n v. National Marine Fisheries Serv., 524 F.3d 917, 931, 38 ELR 20099 (9th Cir. 2008) ("[W]e conclude that the jeopardy regulation requires NMFS to consider both recovery and survival impacts."); *see also* Wild Fish Conservancy v. Salazar, 628 F.3d 513, 518, 40 ELR 20037 (9th Cir. 2010); 16 U.S.C. §1536(a)(2); 50 C.F.R. §402.02 (2009).
12. *National Wildlife Fed'n*, 524 F.3d at 930. *See also* Turtle Island Restoration Network v. U.S. Dep't of Commerce, 878 F.3d 725, 735 (9th Cir. 2017) ("Where a species is already in peril, an agency may not take an action that will cause an 'active change of status' for the worse.").
13. American Rivers v. Federal Energy Regulatory Comm'n, 895 F.3d 32, 47, 48 ELR 20113 (D.C. Cir. 2018). No other circuits have addressed this question.
14. *National Wildlife Fed'n*, 524 F.3d at 936.
15. *Id.*
16. Center for Biological Diversity v. U.S. Fish & Wildlife Serv., 807 F.3d 1031, 1051 (9th Cir. 2015) (citing *National Wildlife Fed'n*, 524 F.3d at 930). This requirement means that these determinations also often involve complicated disputes over separating baseline conditions from proposed actions. For example, if an agency defines all of the negative impacts of operation of a water project as part of the baseline, and any positive aspects of operation as part of the project, by definition, the project could not jeopardize the species. This approach is impermissible. *American Rivers*, 895 F.3d at 47.
17. The Services have promulgated new regulations seeking to change this aspect of the jeopardy determination. The proposed rule explicitly rejected this approach and the line of cases that created it. Endangered and Threatened Wildlife and Plants; Revision of Regulations for Interagency Cooperation, 83 Fed. Reg. 35178, 35182 (proposed July 25, 2018):

> It is sometimes mistakenly asserted that a species may already be in a status of being "in jeopardy," "in peril," or "jeopardized" by baseline conditions, such that any additional adverse impacts must be found to meet the regulatory standards for "jeopardize the continued existence of" or "destruction or adverse modification."

(internal quotation marks omitted). The final rule maintains this same approach. *See, e.g.*, Endangered and Threatened Wildlife and Plants; Regulations for Interagency Cooperation, 84 Fed. Reg. 44976, 44988 (Aug. 26, 2019). Whether these new regulations will survive judicial scrutiny is as yet unclear. This Comment focuses on the legal and scientific challenges of understanding jeopardy in small and declining populations, regardless of the regulatory approach.

18. The requirements for no adverse modification of critical habitat are somewhat more complicated. *Compare* Butte Envtl. Council v. U.S. Army Corps of Eng'rs, 620 F.3d 936, 948, 40 ELR 20144 (9th Cir. 2010), *with* Gifford Pinchot Task Force v. U.S. Fish & Wildlife Serv., 378 F.3d 1059, 1075, 34 ELR 20068 (9th Cir. 2004), *amended*, 387 F.3d 968 (9th Cir. 2004).
19. Center for Biological Diversity v. U.S. Bureau of Land Mgmt., 698 F.3d 1101, 1109, 42 ELR 20211 (9th Cir. 2012) (internal quotations and citations omitted). The court found:

> An agency action is arbitrary and capricious if the agency has: relied on factors which Congress has not intended it to consider, entirely failed to consider an important aspect of the problem, offered an explanation for its decision that runs counter to the evidence before the agency, or is so implausible that it could not be ascribed to a difference in view or the product of agency expertise.

*Id.*

20. Determination of Threatened Status for the Delta Smelt, 58 Fed. Reg. 12854, 12855-56 (Mar. 5, 1993). In 2010, FWS reviewed the smelt's status and determined that an upgrade to endangered status was warranted but precluded. 12-Month Finding on a Petition to Reclassify the Delta Smelt From Threatened to Endangered Throughout Its Range, 75 Fed. Reg. 17667 (proposed Apr. 7, 2010).
21. "'[F]luvial geomorphology' comes from the Greek terms '[g]eo,' meaning earth; 'morphe,' meaning shape; and 'ology,' meaning study, and from the Latin word 'fluvial,' meaning of rivers." Oppliger v. Vineyard, 803 N.W.2d 786, 798 (Neb. Ct. App. 2011). Fluvial geomorphology thus describes "river dynamics and processes, i.e., how rivers move, change, and behave." *Id.*

diverted upstream or exported by huge pumping plants in the south Delta.[22] Although some of these flows could be restored, and most of the disagreement about smelt protection focuses on flow volume through the Delta,[23] climate change and human land use patterns in the Sacramento and San Joaquin watersheds are incompatible with a full-scale reversion to historic flow patterns.[24]

Beyond water quantity and flow timing, humans have changed water quality in the Delta.[25] Salts, toxic chemicals, nutrients, and harmful algal blooms degrade smelt habitat. The historically turbid waters have become clear, which increases predation on smelt, and low in planktonic food for smelt. Huge flows of sediment from Sierra Nevada placer mining in the 19th century altered the Delta's physical structure. Later conversion of the huge tidal marsh into a system of artificial channels and levees to create shipping channels and protect new agricultural land from flooding remade the habitat into the current modified landscape. Finally, non-native organisms (e.g., bivalve mollusks, aquatic plants, and other fish species), some of which disrupt food webs and confound restoration, have invaded the transformed Delta. These species cannot be removed, and in some cases the new species have significant social value.[26]

Over time, these changes created a novel Delta ecosystem that is still changing in ways usually unfavorable to smelt. In particular, habitat in the south Delta is exceptionally impaired and difficult to restore. This region was an important part of the historic range of Delta smelt, and current water management operations continue to pull them into the region, particularly during periods of low precipitation and expanded water export.

Smelt populations have likely been in gradual decline since at least the middle of the 20th century (Figure 1 on next page), a trend consistent with other native and introduced fishes in the Delta. But a more precipitous decline has occurred since the 1980s, tracking a host of changes: increases in State Water Project exports (Figure 2 on page 10718); a cycle of floods and drought during the latter half of the 1980s; an invasive clam that spread through the estuary and filtered the water clear of planktonic smelt food; and invasive weeds that spread widely across the Delta, blocking waterways and transforming former Delta smelt habitat into a clear, food-limited, lake-like environment. The period from 1969-1989 seems to have shifted the Delta away from habitat that supported Delta smelt to habitat that supported a novel ecosystem unfavorable to them. The Delta smelt now appears to be on a trajectory to extinction within the next five years.

Today, standard surveys that once readily found smelt no longer detect them. Special surveys designed to catch Delta smelt find them only rarely. Surveys conducted in fall 2018 and fall 2019 found zero smelt. The specialized Enhanced Delta Smelt Monitoring (EDSM) Program by FWS conducted intense sampling to detect smelt (574 attempts with a large trawl net over four weeks) yet found only nine smelt.[27] The Delta smelt is not yet extinct, but its population is so small as to be almost undetectable.

Delta smelt illustrate many of the challenges of small population conservation: meaningful detection, monitoring, and statistics are difficult; improved habitat conditions may elicit small or no population response; genetic issues may make recovery more difficult; and stochastic events may have disproportionately catastrophic effects. These challenges make the benefits of mitigation, which are supposed to offset known negative impacts, more uncertain and can make reasoned §7 analysis very difficult.

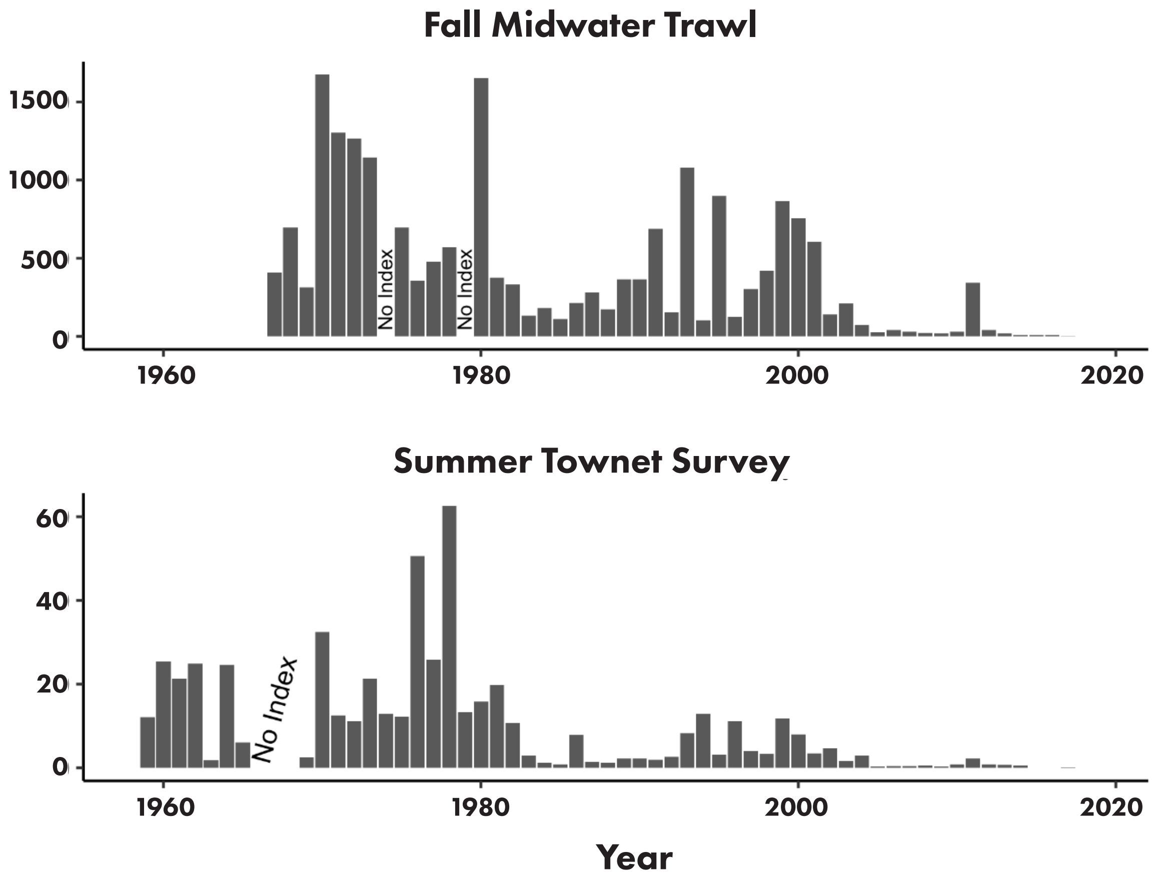
## III. The 2019 FWS BiOp

The Delta lies at the heart of California's two largest water projects, the federal Bureau of Reclamation's Central Valley Project and California's State Water Project. Both projects move water from northern California, across the Delta, and into large pumps that drive the water from the Delta to users across central and southern California. These pumps change the direction, timing, and volumes of flows in the Delta. They also impact Delta smelt directly by drawing smelt into pumps and forebays, where they die, and indirectly by moving smelt into areas of poor habitat in the south Delta and by modifying other Delta conditions. Smelt killed in the pumps may be estimated by monitoring at the pumps, but indirect smelt deaths are much more numerous and harder to estimate.[28]

Reclamation and the state coordinate operation of the projects through a coordinated operations agreement, which must be periodically updated.[29] These updates are a federal action, requiring Reclamation to consult with an expert agency (FWS, for Delta smelt). In 2008, FWS issued a BiOp that determined operation of the pumps jeopardized the smelt's continued existence.[30] FWS created an RPA that allowed the project to operate, but Delta smelt numbers continued to fall and many of the actions

22. James A. Hobbs et al., *Is Extinction Inevitable for Delta Smelt and Longfin Smelt? An Opinion and Recommendations for Recovery*, 15 S.F. Estuary & Watershed Sci. 1, 2 (2017); Peter B. Moyle et al., *Delta Smelt: Life History and Decline of a Once-Abundant Species in the San Francisco Estuary*, 14 S.F. Estuary & Watershed Sci. 1, 2 (2016); Peter B. Moyle et al., *Delta Smelt and Water Politics in California*, 43 Fisheries 42, 42 (2018).
23. See the detailed history of part of the recent litigation in *Natural Resources Defense Council v. Bernhardt*, No. 105CV01207LJOEPG, 2019 WL 937872 (E.D. Cal. Feb. 26, 2019).
24. For an overview of these alterations, see Larry R. Brown & Marissa L. Bauer, *Effects of Hydrologic Infrastructure on Flow Regimes of California's Central Valley Rivers: Implications for Fish Populations*, 26 River Res. & Applications 751 (2010).
25. *See generally* California State Water Resources Control Board, Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary (2018), *available at* https://www.waterboards.ca.gov/plans_policies/docs/2018wqcp.pdf.
26. *See generally* Karrigan Börk, *Guest Species: Rethinking Our Approach to Biodiversity in the Anthropocene*, 2018 Utah L. Rev. 169 (2018).
27. Memorandum from James White, *supra* note 5. The EDSM is labor-intensive. EDSM crews spend up to 12 hours a day on the water, conducting as many as eight trawl net tows at each of many locations. Each tow is limited to 10 minutes to limit the risk of damage to smelt.
28. 2019 FWS BiOp, *supra* note 4, at 138-40.
29. *Id*. at 27.
30. Memorandum from Regional Director, FWS, Region 8, to Operation Manager, Bureau of Reclamation, Central Valley Operations Office (Dec. 15, 2008) [hereinafter 2008 FWS BiOp], https://www.fws.gov/sfbayDelta/Documents/SWP-CVP_OPs_BO_12-15_final_OCR.pdf. The 2008 FWS BiOp replaced a 2004 BiOp after its rejection by a federal court. *Id*.

## Figure 1. Delta Smelt Abundance Index by Year




Note: The *y* axis shows indices of Delta smelt abundance (not actual abundance of the overall population) in the two longest-running fish sampling programs in the Delta. The Summer Townet Survey samples juvenile smelt, while the Fall Midwater Trawl Survey samples subadult smelt, mostly pre-spawning individuals.

Source: Personal Communication with Dylan Stompe, Ph.D. student, University of California, Davis (sourcing data from California Department of Fish and Wildlife, Bay Delta Region, https://wildlife.ca.gov/Regions/3 (last visited July 29, 2020)).

required under the RPA have not been completed.[31] Litigation over the 2008 BiOp is ferocious and still ongoing.[32]

In 2019, however, FWS issued a new BiOp concluding that *increasing* pumped diversions will not jeopardize continued existence of Delta smelt.[33] Specifically, FWS noted that the proposed changes "may increase the level of entrainment of adult and larval Delta smelt relative to [current operations],"[34] but FWS opined that real-time monitoring, habitat improvements, and increased reliance on hatchery smelt production would offset the negative impacts.[35] Based on these benefits, FWS concluded that the proposed actions would not, on the whole, violate §7.[36] There are, however, inherent flaws in their approach.

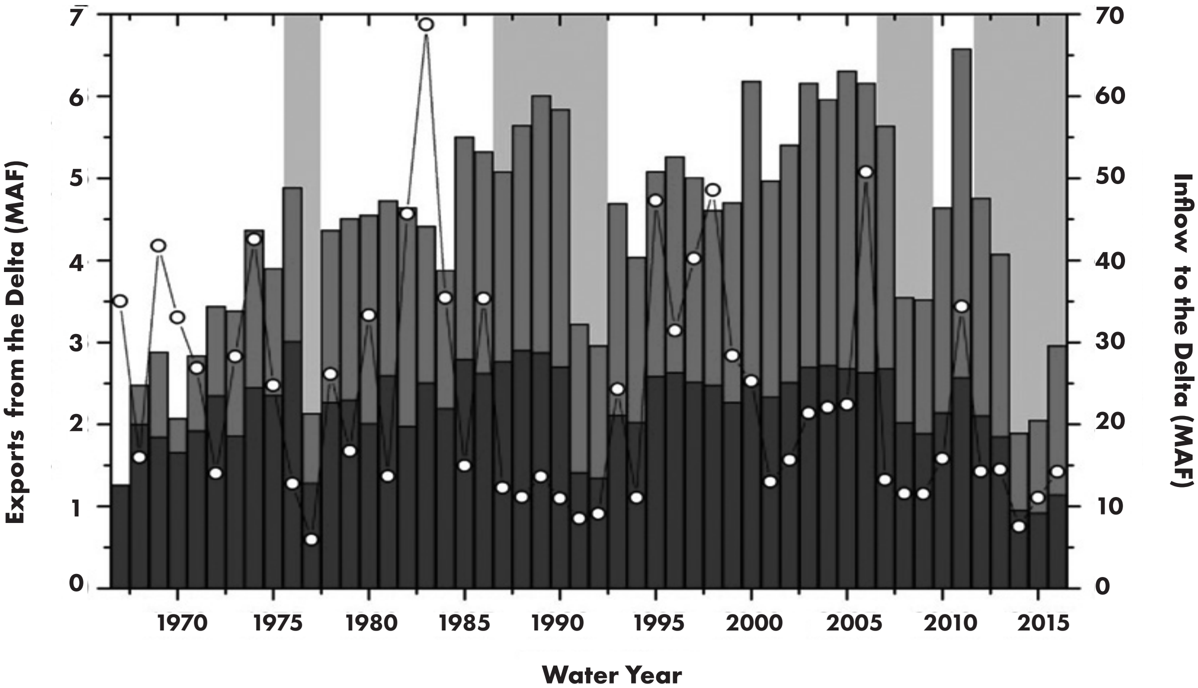
Analyzing FWS' approach in the context of undetectable and/or declining smelt numbers illustrates several challenges to a jeopardy analysis in this common demographic condition.

### *A. Population Estimates and Real-Time Monitoring*

The BiOp relies on detection of Delta smelt through real-time monitoring, but, as noted, the population is too small

31. *See generally* 2019 FWS BiOp, *supra* note 4.
32. Natural Res. Def. Council v. Bernhardt, No. 105CV01207LJOEPG, 2019 WL 937872 (E.D. Cal. Feb. 26, 2019). See additional history in 2019 FWS BiOp, *supra* note 4, at 15-22.
33. Litigation over the 2019 FWS BiOp has already begun, and a federal district court enjoined application of the new BiOps, instead requiring continued compliance with the older BiOps. California Nat. Res. Agency v. Ross, No. 120CV00426DADEPG, 2020 WL 2404853, 50 ELR 20113 (E.D. Cal. May 11, 2020).
34. 2019 FWS BiOp, *supra* note 4, at 220.
35. *Id*. at 220-21.
36. National Wildlife Fed'n v. National Marine Fisheries Serv., 524 F.3d 917, 930, 38 ELR 20099 (9th Cir. 2008). *See also* Turtle Island Restoration Network v. U.S. Dep't of Commerce, 878 F.3d 725, 735 (9th Cir. 2017) ("Where a species is already in peril, an agency may not take an action that will cause an 'active change of status' for the worse.").

## Figure 2. California Delta Inflows and Exports by Year




Note: Annual export (left axis) of water from the south Delta by the State Water Project (medium gray) and federal Central Valley Project (dark gray) in million acre-feet. Light gray areas show periods of drought, when pumping was reduced primarily because of low inflows. Annual water inflows to the Delta in million acre-feet (right axis) are the open circles.

Source: Peter B. Moyle et al., Delta Smelt and Water Politics in California, 43 Fisheries Mag. 42 (2018), *available at* https://afspubs.onlinelibrary.wiley.com/doi/full/10.1002/fsh.10014 (sourcing data from California Natural Resources Agency, Dayflow, https://data.cnra.ca.gov/dataset/dayflow (last updated July 15, 2020)).

for reliable detection. Monitoring small populations in the wild is a common conservation problem.

Under the BiOp, Reclamation and California will reduce their pumping when sampling finds Delta smelt in areas where they could be entrained in the pumps.[37] In theory, this is a great solution—better monitoring leads to better information, which leads to quick changes in operations and better biological outcomes achieved more efficiently. But this logic falls apart when dealing with small, difficult to detect populations. Real-time monitoring relies on the EDSM Program, but even a robust and focused effort like EDSM does a poor job assessing small populations. An independent review panel (IRP) evaluated the EDSM Program in 2017 and highlighted numerous problems.[38]

For example, the panel "was surprised by how much the collection of a single fish could affect the abundance estimates."[39] As the IRP noted:

> [T]here were estimates of zero abundance when no fish were captured, but enormous abundances (hundreds of thousands of fish) were estimated when only one fish was captured. Even though the confidence intervals on the nonzero catch estimates were also very large, it is still difficult to find credibility in such large differences in the point estimates of abundance.[40]

These swings result from the many zero-catch sampling efforts and the low numbers of fish caught. Although the IRP noted some efforts to correct these statistical problems, they remain in more recent monitoring reports: the March 30-April 2, 2020, EDSM report extrapolated a total Delta smelt population estimate of 1.3 million fish from two fish caught in the Lower Sacramento River.[41] Two weeks later, the EDSM estimated a total population of 8,382 fish, and the week before, a population of zero fish. These swings in

37. 2019 FWS BiOp, *supra* note 4, at 151.
38. James A. Gore et al., Delta Stewardship Council, Independent Review Panel (IRP) Report for the 2017 Long-Term Operations Biological Opinions (LOBO) Biennial Science Review (2018), https://www.fws.gov/cno/science/Review%20PDFs/2018/LOBO_EnhancedDeltaSmeltMonitoringProgram_2018-01_FinalReport.pdf.
39. *Id.* at 4.
40. *Id.* at 20.
41. FWS, Enhanced Delta Smelt Monitoring 2020 Phase 2 Sampling Preliminary Analysis Draft 1, 2 (2020), https://www.fws.gov/lodi/juvenile_fish_monitoring_program/edsm/Enhanced%20Delta%20Smelt%20Monitoring%20Report%20%28Weekly%20Summary%29/EDSM_report_2020_05_01.pdf\.

the abundance estimates suggest it is difficult to find credibility in the EDSM's numbers.[42]

Low sample sizes in very small populations are a notorious and inherent problem to sampling and statistical analysis of rare species. Population estimates for small populations are less precise,[43] and the reliability of any monitoring program to detect trends decreases as populations shrink.[44] Although these problems can be mitigated somewhat for population estimation by repeated sampling, these problems cannot be mitigated when attempting to detect smelt for real-time monitoring.

Given these problems and other sampling program limits, the IRP concluded "it is difficult to see how the EDSM currently can be used to inform water operations in near real time."[45] Emerging technologies such as environmental DNA may ultimately be useful for improving or calibrating the EDSM approach, but are too early in the research and development phase to be useful.

In sum, there are too few Delta smelt to detect in a meaningful way. Some individuals are likely to be killed and the population disrupted by the pumps even when sampling does not detect them. The BiOp offers no additional tests for this approach, and its use to offset negative impacts of increased water export is difficult to justify. More broadly, with small populations, detection of individuals and short-term population trends is unlikely, which makes estimating or detecting impacts of federal actions a guessing game.[46]

### B. *Habitat Improvements*

The BiOp also relies on habitat improvements to offset impacts of increased pumping. The BiOp notes "[h]abitat restoration efforts will contribute to the Delta smelt food web once they are constructed and functioning, which is anticipated to contribute to . . . recovery."[47] So, how likely is habitat restoration to support the flagging smelt population? Under the BiOp, some 8,000 acres of tidal and subtidal habitat are required to be restored by 2030.[48] While these improved habitats will benefit multiple species, including native fishes, birds, reptiles, and mammals, there is probably not enough additional habitat (or water) to increase Delta smelt numbers significantly. Even if the habitat were sufficient and perfectly suited to smelt, increasing populations from very low levels takes time and may require additional actions.

The 8,000 acres scattered around the Delta are insufficient to maintain even a small self-sustaining smelt population. Selection of restoration sites thus far has been more opportunistic than strategic, with restoration locations often focusing on wetlands with willing sellers. This results in small habitats that do not provide the range of habitat conditions that smelt need to survive in the highly variable Delta, and the small, scattered, and poorly located habitat may not effectively overlap with the reduced species distribution.[49]

To be successful, habitat restoration must at a minimum include multiple large sites adjacent to the open water corridors (especially the Sacramento River and including the south Delta).[50] Such sites would have to provide spawning habitat, produce the planktonic food Delta smelt require, and provide access to refuges from warm water in late summer. Moreover, to facilitate ongoing export of Delta water, the south Delta habitat must be restored sufficiently to support fish that get carried into the vicinity of the pumps, but are not removed.

The restoration approach seems to assume that merely breaching levees to open wetlands to tidal action will be sufficient to create habitat for smelt. It will not. Tidal aquatic habitats require careful planning, construction, and post-implementation management, including hydrologic regime management. More reliable outflows might improve function in wet years and give better control of where Delta smelt end up, but this approach would require spending water, something resisted by many water users.

42. The BiOp itself acknowledges these challenges, noting:

> [I]t is impossible to accurately quantify and monitor the amount or number of individuals that are expected to be incidentally taken as a result of the [proposed action] due to the variability associated with the effects of the [proposed action], the declining population size of Delta smelt, difficulty in detecting individuals entrained or impinged, annual variations in the timing of various parts of the species' life cycle, and variation in how individual fish use habitat within the Action Area.

2019 FWS BiOp, *supra* note 4, at 394. Instead, the BiOp relies on several surrogates. These in turn rely on a life-cycle model that had not been finalized as of issuance of the 2019 FWS BiOp. *Id.* at 42-43, 151. Reviewing the life-cycle model goes beyond the scope of this Comment, but groundtruthing a life-cycle model is impossible when the population of interest is so small as to be undetectable.

43. Although very few species can be readily observed and counted, the population estimation problem is inherent for most species. For example, elephants seem easy to detect, but even for these massive creatures,

> (a) the smaller the population the less precise the estimate, and (b) our ability to detect a change in numbers decreases as the population shrinks. This problem becomes disproportionately more severe as the population drops to a few hundred animals, when it would be especially important to know whether or not the decline is continuing or has been stabilized or reversed.

Richard F.W. Barnes, *The Problem of Precision and Trend Detection Posed by Small Elephant Populations in West Africa*, 40 Afr. J. Ecology 179, 183 (2002) (citations omitted).

44. *See generally* Barbara L. Taylor & Tim Gerrodette, *The Uses of Statistical Power in Conservation Biology: The Vaquita and Northern Spotted Owl*, 7 Conservation Biology 489 (1993); Jaume Forcada, *Can Population Surveys Show if the Mediterranean Monk Seal Colony at Cap Blanc Is Declining in Abundance?*, 37 J. Applied Ecology 171 (2000).

45. Gore et al., *supra* note 38, at 24.

46. A renewed emphasis on the adverse modification of critical habitat could counter these challenges for small populations, but only in the direction of increasing protections for these populations. *See* Dave Owen, *Critical Habitat and the Challenge of Regulating Small Harms*, 43 ELR 10662, 10663-64 (Aug. 2013).

47. 2019 FWS BiOp, *supra* note 4, at 220.

48. *Id.* at 56.

49. Delta smelt originally inhabited a vast area, about the size of Rhode Island, which included bay and river water, marsh sloughs, and productive wetlands across both brackish and freshwater gradients. Because smelt move with tides and currents, their location shifted across seasons and in response to droughts and floods. Their habitat included multiple spawning sites with characteristics that remain poorly known, making them difficult to target for restoration. *See generally* Joan C. Lindberg et al., *Spawning Microhabitat Selection in Wild-Caught Delta Smelt* Hypomesus Transpacificus *Under Laboratory Conditions*, 43 Estuaries & Coasts 174 (2020).

50. Such sites would have to provide spawning habitat, produce the planktonic food Delta smelt require, and provide, or be close to, refuges from warm water in late summer. *Id.*

Habitat restoration does not provide an alternative to giving fish enough water.

In short, nearly every site will need intensive, continuous biological and hydraulic management to meet even minimum expectations of a restored habitat that can support smelt.[51] For small populations subsisting on small habitats, the habitats must be nearly perfect for the populations to survive. This is not a realistic expectation in most cases.

More broadly, the Delta smelt population has become so low that near-term demographic effects may outweigh effects of long-term habitat improvements. Habitat-based projects take years or decades to implement and mature.[52] And even if ideal habitat could be created instantaneously, the population is small enough that individuals may be unable to find both mates (the Allee effect) and suitable spawning habitat.[53] If the smelt overcome this challenge, rebuilding a population from such low levels takes generations of fish reproduction. In addition, the population is susceptible to many stochastic disruptions that may lead to extinction in the interim, like droughts, new invasive species, toxic spills, or other water quality events.[54] Using habitat improvements, with uncertain long-term benefits, to offset known near-term negative impacts places the risk of failure entirely on the protected species.

The BiOp appears to anticipate these problems, noting "the magnitude of the effect of this component of the [proposed action] is unknown at this time."[55] Nevertheless, the BiOp relies on the restoration efforts for its no-jeopardy conclusion.[56]

### C. Hatcheries

FWS relies on hatchery production to justify impacts from increased pumping: "[t]he increased production at [the University of California, Davis Fish Conservation and Culture Laboratory (FCCL)] and the Delta Fish Species Conservation Hatchery and subsequent supplementation of the wild population will help to offset adverse effects from the operations."[57] Captive populations can be used to support spawning and recruitment failures, with the expectation that increased smelt populations will increase opportunities for natural spawning. This experimental approach has high risk of failure, however.

Successful operation of a hatchery for conservation purposes is difficult when wild populations are very small. Supplementation programs for other species with small wild populations, especially salmon, have not been successful at reestablishing wild, self-sustaining populations, but instead create a reliance on hatchery support.[58] In general, valuing hatchery production over large-scale habitat work is widely recognized as one of the principal failures of the field of fisheries management.[59]

A genetically managed Delta smelt population has been maintained at the FCCL, in collaboration with the University of California, Davis Genomic Variation Laboratory, since 2008.[60] As a conservation hatchery, the FCCL is permitted to collect and incorporate 100 wild Delta smelt into the population annually to increase diversity, reduce inbreeding, and avoid domestication problems. Through careful management, inbreeding has been kept low for the past nine generations,[61] but it cannot be maintained indefinitely without input from the wild population. With the decline of the wild population, the FCCL has been unable to capture the 100 individuals needed, at least for the 2018-2020 spawning seasons.[62] Moreover, as is common in captive populations, genetic adaptation to captivity has been observed in the FCCL population and will continue to increase.[63] The BiOp anticipates greatly expanding the rearing facility and reintroducing fish into the wild, but this approach may not benefit the wild population.

Overall, there is little reason to expect that raising smelt in captivity can, by itself, restore even a small population to the wild, given the current status of Delta smelt and its habitat and given the long history of failure of salmon and trout hatcheries to live up to expectations for maintaining/

51. Most Delta restoration sites, as in the rest of the estuary, are vulnerable to invasion by non-native species that subvert the best-laid restoration plans. These invaders can disrupt or destroy restoration sites for native fishes and may require ongoing management. *See* Hobbs et al., *supra* note 22, at 10.
52. 2019 FWS BiOp, *supra* note 4, at 56. This same habitat restoration anticipated under the 2019 BiOp was required under the 2008 FWS BiOp, but has not yet been completed. *Id*.
53. *See generally* Philip A. Stephens et al., *What Is the Allee Effect?*, 87 Oikos 185 (1999).
54. *See generally* Jason Baumsteiger & Peter B. Moyle, *Assessing Extinction*, 67 BioScience 357 (2017).
55. 2019 FWS BiOp, *supra* note 4, at 180.
56. *See, e.g.*, *id*. at 202 ("The proposal to continue restoring intertidal and associated subtidal habitat in the Delta and Suisun Marsh is a reasonable means of minimizing the adverse effects of the loss of individuals, on the species as a whole."). *See also id*. at 184, 204. For a discussion of the problems with using habitat mitigation to offset water project impacts, see Michael C. Blumm et al., *Still Crying Out for a "Major Overhaul" After All These Years—Salmon and Another Failed Biological Opinion on Columbia Basin Hydroelectric Operations*, 47 Envtl. L. 287, 306-12 (2017).
57. 2019 FWS BiOp, *supra* note 4, at 219.
58. For an excellent overview of these issues, see generally Paul Stanton Kibel, *Salmon Lessons for the Delta Smelt: Unjustified Reliance on Hatcheries in the USFWS October 2019 Biological Opinion*, 47 Ecology L. Currents 209 (2020).
59. *See generally* Greg G. Sass et al., *Inland Fisheries Habitat Management: Lessons Learned From Wildlife Ecology and a Proposal for Change*, 42 Fisheries 197 (2017).
60. *See generally* Joan C. Lindberg et al., *Aquaculture Methods for a Genetically Managed Population of Endangered Delta Smelt*, 75 N. Am. J. Aquaculture 186 (2013).
61. *See generally* Amanda J. Finger et al., *A Conservation Hatchery Population of Delta Smelt Shows Evidence of Genetic Adaptation to Captivity After 9 Generations*, 109 J. Heredity 689 (2018).
62. The existing population may not capture the full range of genetic variation in the wild. The smelt spends its one-year life span in open waters in loose groups, feeding on zooplankton, before spawning and dying. The Delta smelt survived the SFE's highly variable environmental conditions by embracing variable life histories: they can survive as a resident species in freshwater sloughs, in brackish open water, or as a semi-anadromous species, spawning in freshwater but growing to maturity primarily in salt water. *See generally* James A. Hobbs et al., *Complex Life Histories Discovered in a Critically Endangered Fish*, 9 Sci. Rep. 1 (2019). In recent decades, the semi-anadromous life history has been dominant, with juveniles rearing in Suisun Bay and adults migrating into the freshwater Delta for spawning. *Id*. Newly hatched larvae then drift back into the brackish-water-rearing habitat in Suisun Bay to repeat the cycle. *Id*. Scientists are unsure if the life-history strategies result from genetics, specific environmental cues, or both. If these variations are genetic, scientists do not know whether they are all adequately represented in the hatchery population.
63. *Id*.

restoring naturally spawning populations.[64] The existence of a conservation hatchery does provide a fail-safe for when wild populations are officially extinct, and such actions must be tried simply as desperation measures, but relying on the approach to offset negative impacts ignores the historical problems with hatcheries.

### D. Likely Outcomes

Assessing the impacts of any proposed action in isolation is difficult, and assessing it in the context of a very small and declining population is almost impossible. Crafting a no-jeopardy BiOp in this context becomes more an exercise in how to define the environmental baseline[65] and portray limited agency discretion,[66] rather than a serious effort to avoid extinction.

In contrast, stepping back from this individual proposed action, understanding the broader trajectory of Delta smelt as a species is easy. This is a species in crisis, and no actions in the BiOp will change its population trajectory for the better. Based on our experience working with the Delta ecosystem, the following seem the most likely alternative futures for Delta smelt under the BiOp:

1. Substantial or total replacement of the wild, natural population with a population of hatchery origin, continuously supplemented.
2. Extinction of the wild population in one to five years, with a population of increasingly domesticated hatchery smelt kept for display and research.
3. Persistence of a small wild population in a few limited habitats, until these habitats cease being viable (e.g., from global warming).
4. Persistence of the species through establishment of reservoir populations and maintenance of these populations through supplementation.[67]
5. Global extinction after wild populations disappear and hatchery supplementation or replacement fails, followed by failure of a highly inbred hatchery population.

Absent wholesale management changes, wild-born Delta smelt are likely to go extinct before the expiration of this BiOp. Extinction of the Delta smelt would simplify water management and make future BiOps much easier to write and defend.

## IV. Another Approach

Taken as a whole, the ESA gives federal agencies broad species-recovery authority. Although agencies often attempt to diminish their §7 obligations and treat the ESA merely as a permitting act, the ESA has potential to be far more. In bold, aspirational language, the Act aims "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved [and] to provide a program for the conservation of such endangered species and threatened species."[68] U.S. Supreme Court jurisprudence has affirmed the U.S. Congress' aggressive approach: "the language, history, and structure of the legislation under review here indicates beyond doubt that Congress intended endangered species to be afforded the highest of priorities."[69]

Beyond the consultation requirement, §7 explicitly directs federal agencies to promote the purpose of the Act, including an affirmative requirement that they use their authorities to "carr[y] out programs for the conservation of endangered species and threatened species."[70] Although courts do not read this language to place affirmative responsibilities on agencies beyond those spelled out elsewhere in the Act,[71] courts have held this language gives federal agencies the authority to restore listed species.[72] Reclamation and FWS could use this authority to take aggressive action to conserve Delta smelt in ways broadly consistent with water projects in the Delta. Focusing on increasing smelt numbers could increase the population, making future BiOps more defensible.

Aggressive actions could include assisted migration of Delta smelt into other novel habitats, such as reservoirs. A similar species, rainbow smelt, has successfully invaded the Laurentian Great Lakes and is now pushing into deep, cold inland lakes throughout midwestern U.S. states.[73] If deep, cold reservoirs offer habitat to other smelt species, could deep, cold reservoirs in California support Delta smelt? Some reservoirs in California already support inland runs of native Chinook salmon and steelhead termed "adfluvial" runs (live in reservoirs, spawn in the inflow-

64. *See* Stanton Kibel, *supra* note 58, at 214-15.
65. J.B. Ruhl & James Salzman, *Gaming the Past: The Theory and Practice of Historic Baselines in the Administrative State*, 64 Vand. L. Rev. 1, 38 (2011) (observing "[t]he Endangered Species Act ('ESA') offers a minefield of historic baselines ripe for . . . gaming").
66. *See generally* J.B. Ruhl & Kyle Robisch, *Agencies Running From Agency Discretion*, 58 Wm. & Mary L. Rev. 97 (2016).
67. *See* discussion *infra* Part IV.
68. ESA §2(b), 16 U.S.C. §1531(b). This reflects an era of environmental law marked by wild optimism about humanity's ability to change the nature of our relationship with the environment. *See*, *e.g.*, Clean Water Act §1(a)(1), (2), 33 U.S.C. §1251(a)(1), (2) (setting "the national goal that the discharge of pollutants into the navigable waters be eliminated by 1985" and that waters support fish and water-based recreation by 1983).
69. Tennessee Valley Auth. v. Hill, 437 U.S. 153, 8 ELR 20513 (1978).
70. ESA §7(a)(1), (2), 16 U.S.C. §1536(a)(1), (2). The Act defines 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 Act are no longer necessary." ESA §3(3), 16 U.S.C. §1532(3).
71. *See*, *e.g.*, City of Santa Clarita v. U.S. Dep't of Interior, No. CV02-00697 DT, 2006 WL 4743970, at **29-31 (C.D. Cal. Jan. 30, 2006). *See generally* J.B. Ruhl, *Section 7(a)(1) of the "New" Endangered Species Act: Rediscovering and Redefining the Untapped Power of Federal Agencies' Duty to Conserve Species*, 25 Envtl. L. 1107 (1995); William M. Flevares, *Ecosystems, Economics, and Ethics: Protecting Biological Diversity at Home and Abroad*, 65 S. Cal. L. Rev. 2039, 2051 (1992) ("Courts have specifically indicated that the ESA is not to be used as a mechanism for comprehensive planning but should only be concerned with the specific problems of listed species.").
72. Carson-Truckee Water Conservancy Dist. v. Clark, 741 F.2d 257, 261, 14 ELR 20797 (9th Cir. 1984).
73. *See generally* Norman Mercado-Silva et al., *Forecasting the Spread of Invasive Rainbow Smelt in the Laurentian Great Lakes Region of North America*, 20 Conservation Biology 1740 (2006); Brian M. Roth et al., *A Simulation of Food-Web Interactions Leading to Rainbow Smelt* Osmerus Mordax *Dominance in Sparkling Lake, Wisconsin*, 77 J. Fish Biology 1379 (2010).

ing rivers).[74] Several California reservoirs already have self-sustaining populations of wakasagi, a non-native Japanese smelt related to Delta smelt. These patterns raise the possibility that Delta smelt could survive in some California reservoirs.[75] If it appears Delta smelt can live in reservoirs, establishing reservoir populations could enhance genetic diversity and provide another backup habitat to prevent extinction, at least in the short term.

Alternatively, managers could seek to create a water allocation for smelt, giving them a seat at the water-rights negotiating table. This would offer dual benefits: increased water for the smelt and a flexible approach to using that water. An environmental water right of perhaps one to two million acre-feet per year could increase the probability of success for habitat restoration. Portions of the water right could be sold to provide necessary restoration funding. This is difficult to envision, given the current conflicts in the Delta over future pump operations, the ongoing lawsuits over the revised Bay Delta Plan revision for the Lower San Joaquin River, and the forthcoming Bay Delta Plan revision for the Sacramento River. But the Bay Delta Plans do set aside significant water for Delta fish, which could be managed as an environmental flow right.

If decisionmakers lack an appetite for such aggressive experimental actions, the Act offers a third path. When an expert agency cannot logically conclude that a proposed 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 [its] habitat of such species," project proponents can apply for an exemption from the Endangered Species Committee, colloquially known as the God Squad.[76] The Committee weighs the costs and benefits of the project, the public interest, the regional and national significance of the project, and other factors, and may then choose to allow the project to proceed if the benefits outweigh the costs, notwithstanding the risk of extinction for the species.

For projects affecting critically endangered, low-population species like the Delta smelt, this approach would more accurately reflect the difficulties inherent in estimating negative project impacts and positive mitigation benefits. An honest accounting of these difficulties is more a legally defensible approach, with the added benefit of political accountability. Political accountability is lacking when a BiOp provides superficially credible but ultimately dubious assurances that a project will not drive a species to extinction.[77]

## V. Conclusion

The Delta smelt has become so rare that improving the species' status will be very difficult. Relying on these hoped-for improvements to offset known negative impacts in a BiOp finds no support in the science of small populations. Species with exceedingly small populations, such as the Delta smelt, are difficult to manage under the best of conditions, and the success of projects designed to benefit populations in this position is always uncertain. Using uncertain benefits to offset likely negative impacts both invites legal challenges and increases extinction risk.

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74. *See generally* K. Martin Perales et al., *Evidence of Landlocked Chinook Salmon Populations in California*, 35 N. Am. J. Fisheries Mgmt. 1101 (2015).
75. Teejay O'Rear et al., Delta Smelt and Salmon Habitats Beyond the Estuary, Presentation (2018), https://watershed.ucdavis.edu/library/delta-smelt-and-salmon-habitats-beyond-estuary. Reservoir Delta smelt populations may already exist, established by fish being carried down the California Aqueduct, although this may be just wishful thinking.
76. ESA §7(e), (g), 16 U.S.C. §1536(e), (g).
77. ESA §7, 16 U.S.C. §1536.