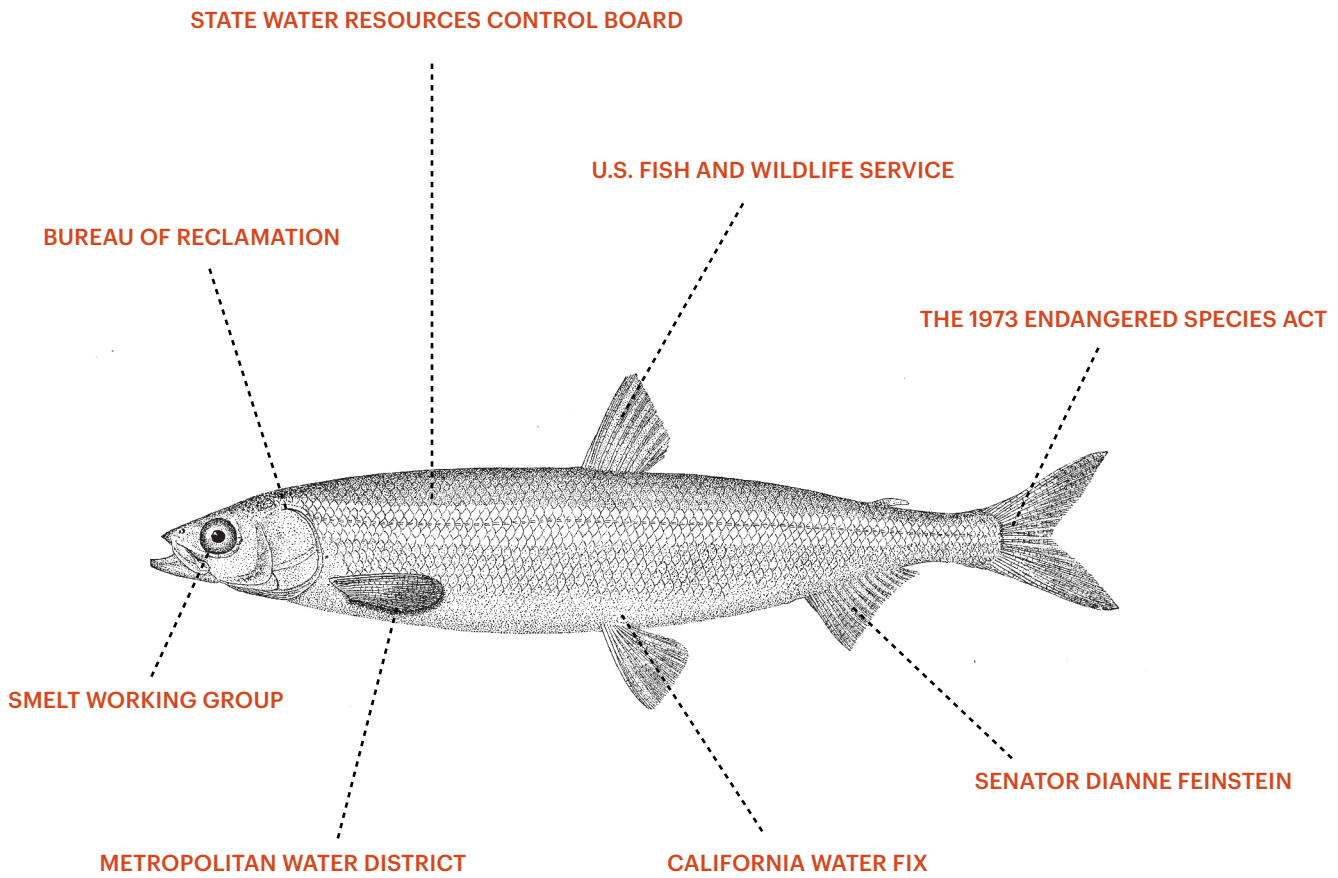
# the zone of entrainment



# We know that environmental concerns have been used to block infrastructure projects. But can infrastructure be used to side-step environmental concerns? Andrew Lakoff on water provision and species protection in California.

**IN MARCH 2016, FEDERAL WILDLIFE OFFICIALS** faced a barrage of criticism from California politicians concerning the regulation of the state's water system. Senator Dianne Feinstein and a group of Republican congressmen from the Central Valley each sent public letters to President Obama demanding that he order the U.S. Fish and Wildlife Service to relax its restrictions on water system operators in the San Francisco Bay-Delta.

The letters noted that recent storms in Northern California had markedly increased the flow of water from the Sacramento River into the delta, but that endangered species regulations sharply limited the amount of this water that could be shipped south. After four years of severe drought, Central and Southern California water contractors were livid that they would not be able to use this winter's relative bounty of water to replenish their drained aquifers and reservoirs. Even though river flows had more than doubled during the late winter storms, Feinstein argued, less water was being pumped to the south than during the same period of the prior year. The waste was "inexcusable," she continued, citing data on the amount of water that should have been diverted south by water operators: "180,000 to 200,000 acre-feet of water was allowed to flow out to the sea instead of being captured and stored—enough water to supply 360,000 homes for a year" (Feinstein 2016b). She urged regulators to let state and federal water projects pump at the maximum allowable levels during times of high storm water flow: "If we can't increase pumping during an El Niño year, then when else can we?" Similarly, the Central Valley legislators demanded that pumping rates from the delta be increased "over and above" the maximum amount allowed by the regulations: "The fate of California and the lives and livelihoods of our constituents are at risk" (McCarthy et al. 2016).

The specific focus of the lawmakers' criticism was the use of federal endangered species regulations to protect the delta smelt, a once abundant fish whose population has fallen in recent years to alarmingly low levels. The Fish and Wildlife Service is required, under these regulations,

to limit the rate of pumping by the water projects' facilities at the southern end of the delta when there is a danger that the endangered fish might be sucked in, or "entrained," by the pumps. Over the last decade, smelt protections have been a target of ongoing criticism for those—especially in the agricultural Central Valley—who argue that environmental regulation is strangling the state's economic productivity. But beyond the issue of how to weigh the protection of the delta's fish against the demands of farms and cities to the south, the debate points to a more general question about the operation of vital infrastructures such as California's public water circulation system: How, in an age of concern about the environmental consequences of modernization processes, do ecological needs recast infrastructural norms?

## THE VALUE OF ENVIRONMENTAL THINGS

California's water circulation system comprises a vast network of dams, reservoirs, and canals that deliver water from the wetter northern and eastern parts of the state to its drier southern and western regions. The system's main components were built between the 1930s and the 1960s, following the mid-twentieth century model of government-built public works projects (Reisner 1986). According to this model, technocratic planning was oriented to the instrumental use of "natural resources" for social and economic purposes such as increased energy generation and agricultural productivity. In the cost-benefit calculations made by government agencies such as the Bureau of Reclamation to justify its dam and reservoir projects, potential ecological harms were not taken into account. Indeed, sophisticated intellectual tools were not yet available for measuring the condition of the environment and for projecting the damage to this condition that might be inflicted by such projects.

As early as the 1930s, but with increasing clamor by the 1960s, critics began to point to the unintended consequences of public infrastructure projects (Collier 2014), arguing that engineered systems for generating electricity, increasing agricultural productivity, and expanding habitable terrain were having disastrous effects on wildlife and on ecosystems. New publics emerged to speak for


**FIGURE 1 (PREVIOUS PAGE LEFT):** The California Aqueduct and the Delta-Mendota Canal.
PHOTO BY DOC SEARLS

**FIGURE 2 (PREVIOUS PAGE RIGHT):** The delta smelt.
PHOTO BY U.S. FISH AND WILDLIFE SERVICE/PETER JOHNSEN

**FIGURE 3 (THIS PAGE):** California Department of Fish and Wildlife found one lone smelt when they sampled 40 locations throughout the delta in April 2016.

those beings under threat from human-built systems, new fields of expertise were invented to monitor the well-being of native flora and fauna, and regulations were put in place to protect this environment from the side effects of human-built systems.

The 1973 Endangered Species Act was a major outcome of this newly articulated government responsibility to mitigate the ecological damage caused by public infrastructure development. The Act requires any federal agency whose planned action may "jeopardize the continued existence" of a threatened species to consult in advance with wildlife officials, who then identify a set of "reasonable and prudent alternatives" that can mitigate the threat to the species while enabling the agency to go ahead with its planned action in modified fashion (Lakoff 2016).

Over the last four decades, the Endangered Species Act has proven to be an especially powerful regulatory tool because it does not allow government agencies to engage in a cost-benefit analysis in determining how or whether it is to be enforced. According to the Act and subsequent court rulings, the value of the continued existence of a species is "incalculable." The Supreme Court upheld this principle in the case of *Tennessee Valley Authority v. Hill* (1977), ruling that the preservation of an obscure fish—the snail darter—had priority over any benefits that might accrue from the construction of a costly dam project. As the majority opinion put it, the duty of federal wildlife officials is to "halt and reverse the trend toward species extinction, *whatever the cost*" (italics added). In other words, the benefits of the resources to be extracted by an infrastructure project could not be weighed against the cost of the loss of a species whose existence was threatened by the project. According to the Court, these two forms of value were incommensurable.

For this reason, the US Fish and Wildlife Service's 1993 decision to list the delta smelt as threatened has had a profound effect on water politics in California (Alagona 2013). The effect has become more pronounced in the wake of an important 2007 federal district court ruling that the operations of the state and federal water projects imperiled the survival of the smelt. The ruling required the Fish and Wildlife Service to closely monitor the wellbeing of the smelt population, and to calibrate the pumping operations of the state and federal water projects in relation to the results of such monitoring (San Luis & Delta-Mendota Water Authority v. Jewell [9th Cir. 2014]). The resulting restrictions, argue Central and Southern California water managers, have markedly reduced the amount of water available in storage. According to the Metropolitan Water District, which provides water to 17 million people in Southern California, 1.43 million acre-feet of water has been lost since 2008 due to endangered species-related restrictions placed on pumping (Maven 2016).

From the perspective of those who advocate for the protection of the delta's native fish species—an alliance of environmental advocacy organizations, delta farmers, and sport-fishing lobbyists—the delta smelt is not the object of value per se. Rather, the smelt is an "indicator species," a sentinel for the declining health of the delta ecosystem more generally. But since endangered species regulations must focus on a single threatened species, efforts to protect the smelt have come to stand in for the more abstract—and difficult to measure—effort to improve the wellbeing of the ecosystem. However, the use of the smelt as a proxy for the ecosystem has the complicated effect that regulatory measures end up focusing as much or more on preserving smelt existence as on broader ecological aims such as limiting the salinity levels of the delta or minimizing the incursion of invasive species.

Let us now return to the 2016 debate over regulations designed to protect the smelt from the water projects' pumping operations, with particular attention to the techniques used by wildlife officials to gauge and manage the wellbeing of the smelt population. In their practices of risk assessment, we can see the attempt to integrate ecological knowledge into the everyday operations of vital infrastructures.

## THE ASSESSMENT OF ENTRAINMENT RISK

Wildlife biologists monitor the smelt population in relation to its historical prevalence through regularly conducted fish surveys. In these "trawls," a boat trails a net for a set amount of time through specific sites in the delta, and the number of each species caught is registered. Since these surveys were first conducted in the 1960s, the number of native fish caught in the nets has declined markedly, not only for delta smelt, but also for other species such as steelhead trout and the winter-run Chinook salmon. By the end of 2015, specialists on native fish in the delta agreed that the smelt were close to extinction. Only seven had been found in the year's Fall Midwater Trawl, by far the lowest number ever recorded. For this reason, Fish and Wildlife Service officials were highly attuned to the needs of the smelt as they entered their most sensitive period of the year, the months from January to March when they migrate upriver and spawn.

The specific task of wildlife officials was to protect the weak-swimming smelt—especially gravid females, juveniles and larvae—from the massive pumping facilities at southern end of the delta that transfer water into the state and federal water projects. These pumps reverse the course of the delta's rivers, diverting water south at a maximum rate of 10,000 cubic feet per second. The key question regulators had to ask was whether, in this delicate late winter period, vulnerable smelt were present in the "zone of entrainment": the section of the delta in which reverse currents are strong enough to pull fish into the pumps to their death. And if so, what was the optimal rate of pumping to limit the risk of entraining the vulnerable fish while at the same time enabling the water projects to capture runoff from the long-awaited winter storms?

On roughly a weekly basis during this period, a group of fish biologists from several state and federal agencies, known as the Smelt Working Group, met to assess the risk posed to the smelt by water project operations and to make recommendations to the Bureau of Reclamation and the State Water Project on maximum pumping rates. The stakes of its risk assessment were high: the difference between allowing a pumping rate of -5,000 cubic feet per second (the maximum allowable under the regulations)

and -1,250 cubic feet per second (the minimum) would quickly add up to tens of thousands of acre-feet either in reservoir storage to the south or in freshwater flowing "out to the sea," as Feinstein put it. To make a recommendation, the working group analyzed data on such factors as the temperature and turbidity of the delta's water, the flow rates of its tributaries, and the abundance and location of smelt as measured by "early warning" surveys.

In its January meetings, the working group focused on how to protect adult female smelt during their period of migration just before spawning. One problem in making recommendations was that there were so few smelt remaining in the delta that it was hard to know where they were. Overall, the group admitted, "current distribution is unclear." But it argued that given the "depressed level of abundance" of the smelt, the Fish and Wildlife Service "must take a precautionary approach to protect this portion of the population during the critical migration and spawning period" (US Fish and Wildlife Service 2016a). Based on the working group's recommendation, the Fish and Wildlife Service reduced the maximum pumping rate to -2,500 CFS over a 14-day period beginning in late January.

In the following weeks, water agencies to the south expressed increasing agitation about the regulatory decisions that were limiting their expected deliveries from Northern California storms. Feinstein articulated their concerns in a March 11 statement: "Days of high flows were squandered," she complained. "Rather than pumping as much water as possible" during post-storm periods, "pumping levels were ratcheted down for an entire month between mid-January and mid-February" (Feinstein 2016a). She questioned the rationale for the Fish and Wildlife Service's interventions: "In some instances these decisions were made even though available data suggested no smelt or salmon were anywhere near the pumps." And she called for a new regime of "daily monitoring of fish near the pumps during times of high turbidity" so that "real-time data can be used to inform decisions rather than relying on intuition" (ibid.).

At around this time, however, a new regulatory criterion came into play for the Smelt Working Group. The temperature of the delta reached 12 degrees Celsius, the threshold at which experts think that smelt spawning activity begins. For this reason, there was a "probable presence of larval delta smelt in the south and central delta," according to the working group. Given its understanding that "eggs and juvenile smelt emulate free floating particles in the water column," the working group argued, it was necessary to again reduce the speed of reverse flows to avoid entraining the young fish (US Fish and Wildlife Service 2016b). Using a flow modeling technique, the working group calculated the entrainment risk to the larvae at a flow rate of -5,000 CFS to be between 50% and 60%. Based on these findings, Fish and Wildlife Service regulators released their determination to the Bureau of Reclamation on March 24: given indications of the "potentially persistent presence of the early life-history stages of Delta Smelt in a region vulnerable to entrainment at more negative OMR [old and middle river] flows," reverse flows should be no higher than -2,500 CFS over a two-week period (US Fish and Wildlife Service 2016c).

This decision further inflamed defenders of regular water deliveries to the south. In her March 24 letter to President Obama, Feinstein attacked the regulators' precautionary approach: not only do the agencies restrict pumping when smelt are found far away from the pumps, she wrote, "they will also reduce pumping due to the absence of smelt, based on the idea that historically low smelt populations make detection difficult" (Feinstein 2016b). She pointed to "a fundamental problem with our water system: a dogmatic adherence to a rigid set of operating criteria that continues to handcuff our ability to rebuild our reserves" (Feinstein 2016b). More accurate knowledge about the actual presence of smelt near the pumps, she argued, would lead to "a more nimble system": in other words, to higher pumping rates during winter storms. A Northern California congressman, Rep. Jared Huffman of Marin County, countered that in fact the regulatory science was sound: "The U.S. Fish and Wildlife Service is using the real-time monitoring protocols that everyone has been asking for" (Lochhead 2016).

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Over the following months, the debate remained unresolved, as House and Senate "drought relief" legislation seeking to modify the application of endangered species regulations foundered in a more general legislative standstill. But it was worth noting the terrain on which the political debate over water distribution was being conducted: over the methods and findings of a relatively novel type of science that sought to care, in great detail, for the living and reproductive conditions of an obscure, but increasingly endangered, population of fish.

## INFRASTRUCTURAL BYPASS

If the short-term fight was over issues such as maximum pumping rates and methods of tracking fish, a longer-term struggle over the future relation of vital infrastructure to ecosystem health was unfolding at the same time.

The State Water Resources Control Board was preparing to hold what promised to be contentious hearings over the proposed $15 billion California Water Fix, which, if built, would be one of the largest public infrastructure projects in the state's history. The Water Fix, supported by Governor Brown as well as Central Valley and Southern California water suppliers, sought to stabilize and secure deliveries of fresh water from the delta to the south through the construction of two 30-mile-long and 40-foot-wide tunnels that would take water directly from the Sacramento River directly north of the delta to the pumps at the south end. The water could then be pumped at high rates without concern about directly disturbing the smelt or other endangered fish in the delta.

In late March, the Bay-Delta Imported Water Supply Program Manager for the Metropolitan Water District reported to members of Metropolitan's Bay-Delta Committee that if the Water Fix project had already been in place, "with the new modern system with more fish friendly intakes," from January 1 through March 3 "we could have put about another 486,000 acre-feet in storage—enough for 3.6 million people" (Maven's Notebook 2016). Notably, the proposed tunnels were not projected to increase the total amount of water going to the south; rather, the goal was to ensure a steady future rate of pumping so that suppliers would not find themselves beholden to the unpredictable meanderings of endangered fish. This new moment of massive infrastructure construction was an attempt not to resolve, but to bypass, the long-running tension between the human demand for resources and the requisites of ecosystem health. ■

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