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Judging Science: The Rewards and Perils of Courts as Boundary Organizations

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Abstract

Courts have become increasingly important arenas for mediating between competing interests in the interpretation and implementation of science-informed public policies. This function becomes particularly pronounced in the deliberations over the implementation of detailed legislative mandates and administrative rules by federal agencies. These public policies often involve complex social-ecological system relationships and become enmeshed in "wicked problems" without clear resolution, and susceptible to intense rounds of litigation. This paper reviews the literature on boundary organizations, which serve the role of intermediary between the scientific community and policymakers, with an emphasis on adaptive decision-making processes in response to high levels of complexity and uncertainty. This model is then applied to trial and appellate courts, with particular attention toward how courts serve as a forum for the communication and comparative analysis of competing and conflicting scientific research. In this setting, the judge (or judges) can serve as a

critically important gatekeeper in overseeing the inclusion or exclusion of scientific research and the testimony of expert witnesses during court proceedings. The discretion given to trial judges during appellate review underscores the pivotal role of the court of first instance in monitoring the admissibility of "best available science" in judicial proceedings. The benefits and shortcomings of having these societal functions fulfilled by judges, who are often not extensively trained in scientific methodologies and research approaches, are reviewed. Finally, recommendations for further study are offered to investigate the relative capacities of the courts as boundary organizations in greater detail.

I. Introduction

> It is the aim of litigation to achieve social peace.
>
> ~Judge Leon Yankwich[1]

> I hear the jury's still out on science.
>
> ~Gob Bluth, Arrested Development[2]

The trajectory of environmental governance and legal scholarship over the past forty years has followed ecology in embracing complexity and uncertainty.[3] Not only are ecosystems complex by themselves, but they are

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1. Leon Yankwich, *Crystallization of Issues by Pretrial*: A *Judge's View*, 58 COLUM. L. REV. 470, 478 (1958).

2. *Arrested Development*: *Notapusy* (Imagine Television et al. Nov. 7, 2005).

3. Fred P. Bosselman & A. Dan Tarlock, *The Influence of Ecological Science on American Law*: *An Introduction*, 69 CHI.-KENT L. REV. 847 (1994); A. Dan Tarlock, *The Nonequilibrium Paradigm in Ecology and the Partial Unraveling of Environmental Law*, 27 LOY. L.A. L. REV. 1121, 1139 (1994).

part of larger social-ecological systems that are even more complex.[4] Nature is in a constant state of flux and human influence cannot be removed from it.[5] The conflicts that arise over competing uses for natural resources are by their nature complex and remarkably difficult to resolve as well. They are classic "wicked problems"[6] that "cannot be separated from issues of values, equity, and social justice."[7]

4. Complex systems are characterized by multiple elements that interact in interdependent and dynamic ways. *See, e.g.*, EDELLA SCHLAGER & WILLIAM BLOMQUIST, EMBRACING WATERSHED POLITICS 10, 12 (2008); Elinor Ostrom et al., *Going Beyond Panaceas*, 104 PROC. NAT'L ACAD. SCI. 15176 (2007); Elinor Ostrom, A *Diagnostic Approach for Going Beyond Panaceas*, 104 PROC. NAT'L ACAD. SCI. 15181 (2007); Elinor Ostrom, A *General Framework for Analyzing Sustainability of Social-Ecological Systems*, 325 SCI. 419 (2009).

5. *See, e.g.*, Carl J. Walters & Crawford Stanley Holling, *Large-scale Management Experiments and Learning by Doing*, 71 ECOLOGY 2060, 2067 (1990). This shift has implications for ecosystem management and governance, in no small part because the major environmental laws—for example, the Endangered Species Act and the Clean Water Act—were written under a different paradigm that assumed nature could reach a state of equilibrium and human influence could be removed from ecosystems. Tarlock, *supra* note 3; J. B. Ruhl, *Thinking of Environmental Law as a Complex Adaptive System: How to Clean Up the Environment by Making a Mess of Environmental Law*, 34 HOUST. L. REV. 933 (1997); J.B. Ruhl, *Regulation by Adaptive Management—Is It Possible*, 7 MINN. J.L. SCI. & TECH. 21 (2005); Robin Kundis Craig & J.B. Ruhl, *Designing Administrative Law for Adaptive Management*, 67 VAND. L. REV. 1 (2014); Robin Kundis Craig & Melinda Harm Benson, *Replacing Sustainability*, 46 AKRON L. REV. 841 (2013); Robert L. Glicksman, *Climate Change Adaptation: A Collective Action Perspective on Federalism Concerns*, 40 ENVTL. L. 1159 (2009); Holly Doremus, *Adaptive Management, the Endangered Species Act, and the Institutional Challenges of New Age Environmental Protection*, 41 WASHBURN L.J. 50 (2001); Holly Doremus, *Adaptive Management as an Information Problem*, 89 N.C. L. REV. 1455 (2010); Holly Doremus, *Through Another's Eyes: Getting the Benefit of Outside Perspectives in Environmental Review*, 38 B.C. ENVTL. AFF. L. REV. 247 (2011).

6. *See, e.g.*, Horst W.J. Rittel & Melvin M. Webber, *Dilemmas in a General Theory of Planning*, 4 POL'Y SCI. 155 (1973).

7. Donald Ludwig, *The Era of Management is Over*, 4 ECOSYSTEMS 758 (2001); Denise Lach et al., *Taming the Waters: Strategies to Domesticate the Wicked Problems of Water Resource Management*, 3 INT'L J. WATER 1 (2005).

W*icked problems* are remarkably complex and seemingly intractable issues which Rittel and Weber first characterized by describing ten components.[8] For present purposes, these can be consolidated to three common elements. First, the problem cannot be definitively described; in other words, "knowing what distinguishes an observed condition from a desired condition" is not possible.[9] Second, wicked problems involve some aspect of fairness or equity, which is disputed among the stakeholders. Third, there is no such thing as a lasting definitive solution to a wicked problem. This element is a bit trickier than the prior two, because it can only be assumed to be an element from past and present context, until disproven at some point in the future. Nonetheless, the presence of ad hoc measures to alleviate the negative consequences of the problem and the persistence of the problem despite attempts to solve it strongly suggest that the problem is a "wicked" one. Yet, such seemingly intractable conflicts still excite a broad variety of stakeholders, demanding the attention and action of policymakers. We should stress at this point that "wickedness" does not mean unmanageable and is not an excuse for inaction or avoiding the underlying policy problems.

The shift toward embracing complexity has likewise been made in social-science models of how science interacts with policy. The linear model of basic science research leading to applied science that brings benefits to society has been replaced by more nuanced—and historically accurate—models, in which society has a greater say in the scientific process. Several commentators argue that the social contract between society and science has changed.[10] What society now demands is science that is socially robust, where society can talk with science and aid in its production, rather than just be the recipient of scientific knowledge.[11] This new contract puts more strain on experts, in part because the complex problems are more likely to be beyond the specific understanding on any one expert or discipline, but also because the "legitimacy" of experts is no longer assumed.[12] Narratives that involve broad participation are therefore essential to socially acceptable science.[13] In recent years there have been mounting calls from social

8. *See, e.g.*, Rittel and Webber, *supra* note 6.

9. *Id.* at 159.

10. *See, e.g.*, D.E. STOKES, PASTEUR'S QUADRANT: BASIC SCIENCE AND TECHNOLOGICAL INNOVATION (1997); Michael Gibbons, *Science's New Social Contract with Society*, 402 NATURE C81 (1999).

11. *Id.*

12. *Id.*

13. *Id.*

scientists, policymakers, natural scientists, and advocacy organizations for socially informed science with more stakeholder involvement.[14]

A variety of organizations and methods exist to facilitate dialogue between the needs and desires of society and the production of science. These devices for producing socially relevant science are broadly categorized as "boundary organizations"[15] and transdisciplinary methodologies (or "transdisciplinarity").[16] They both stress the importance of nonscientist stakeholder involvement in question crafting and scientific research.[17] An underlying assumption of these approaches is that multiple societal values can be sufficiently resolved and prioritized through consensus processes to guide science production.[18] While such processes can be successful, it depends on what problem is being addressed.

When boundary organizations come up against issues related to natural resource management, they face the mess of conflicting societal values, uses, and priorities that form the tangled, but not unmanageable, knot of wicked problems. In these situations, consensus processes—or worse, undefined processes—fail to resolve basic questions of competing values. The shortcomings of the Glen Canyon Dam Adaptive Management Program ("AMP") illustrate this point. The Glen Canyon AMP was created by the Secretary of the Interior[19] to manage flows of the Colorado River from the Glen Canyon Dam through science-based experimentation in a way that

14. Heather J. Aslin & Kirsty L. Blackstock, *'Now I'm Not an Expert in Anything': Challenges in Undertaking Transdisciplinary Inquiries Across the Social and Biophysical Sciences, in* TACKLING WICKED PROBLEMS THROUGH THE TRANSDISCIPLINARY IMAGINATION 117 (Valerie A. Brown et al. eds., 2010).

15. Thomas F Gieryn, *Boundary-work and the Demarcation of Ccience from Non-science: Strains and Interests in Professional Ideologies of Scientists*, 48 AM. SOCIOL. REV. 781 (1983).

16. Aslin & Blackstock, *supra* note 14.

17. Gieryn, *supra* note 15; Aslin and Blackstock, *supra* note 14.

18. *Compare* Lawrence Susskind et al., *A Critical Assessment of Collaborative Adaptive Management in Practice*, 49 J. APPLIED ECOLOGY 47, 47 (2012) (discussing failed stakeholder processes) *with* Lance Gunderson & Stephen S. Light, *Adaptive Management and Adaptive Governance in the Everglades Ecosystem*, 39 POL'Y SCI. 332, 326–27 (2006) (discussing the Everglades adaptive management stakeholder process).

19. Notice of Establishment for Glen Canyon Dam Adaptive Management Work Group, 62 Fed. Reg. 6264 (Feb. 11, 1997).

mitigated and resolved the competing uses of the river.[20] The conflict-mitigation purpose of the program depended on a stakeholder working group, whose members were determined by charter to include state and federal agencies, tribes, state governments in basin, environmental groups, recreation groups, and power purchasing contractors.[21] Although the program did have some successful experiments, there has been no management change as a result of those experiments.[22] The program's major weakness was that it failed to set priorities among competing uses and assumed that the stakeholder group could resolve its differences without a set structure.[23] Additionally, the relationship between the stakeholder group and scientists was not well defined.[24] Even though the program performed experiments and stakeholders had a mechanism for communication, the lack of well-defined rules and priorities created a nonadaptive program that resulted in more litigation.[25]

It is our contention though that boundary organizations and transdisciplinarity do not stop at the steps of the courthouse. Rather, courts themselves act as boundary organizations, and litigation offers a parallel route to transdisciplinarity. In natural resource and environmental disputes the court functions as a historically rooted intermediary between science and policy. Most models and descriptions of boundary organizations would insist that science production is now a nonlinear joint venture between science and society, with society helping to craft scientific questions. However, many boundary organizations originate in the scientific community and then seek appropriate suitors in society to fund and use their product.[26] If this is true, then courts provide an alternative path, where

20. Alejandro E. Camacho, *Adapting Governance to Climate Change: Managing Uncertainty Through a Learning Infrastructure*, 59 EMORY L.J. 1 (2009); Susskind et al., *supra* note 18, at 47.

21. Susskind et al., *supra* note 18, at 48.

22. *Id.*

23. *Id.* ("The Grand Canyon Protection Act of 1992 was expected to reduce conflict and clarify how the dam should be operated. Unfortunately, the U.S. Congress simply reiterated the importance of water management, power generation, and environmental, cultural and recreational resources, failing to set priorities among these competing concerns.").

24. *Id.*

25. *Id.*

26. *See* Laurens Hessels et al., *In Search of Relevance: The Changing Contract Between Science and Society*, 36.5 SCI. & PUB. POL'Y 387–401 (2009); *cf.* Laurens Klerkx & Cees

the *starting point* is values and priorities—as codified in statutes and formalized in common law. For example, the Endangered Species Act ("ESA") places the value of species protection far beyond those of most economic concerns.[27] It is worth noting that codified values and common law are rough approximations of the values of the time the case is litigated.[28] As Justice Louis Brandeis wrote, "[l]aw has everywhere a tendency to lag behind the facts of life."[29]

In Part I of this article, we make the case for considering courts as a type of boundary organization. We will use the litigation over the federally listed endangered delta smelt fish in California as a case study to demonstrate the ways in which courts can become deeply enmeshed in the scientific complexities of fishery management and water allocation, to the point where they guide and inform the process of socially relevant science production. Specifically, the federal district and appellate courts played decisive roles in setting the timeline for scientific production, defining ecological thresholds, and deciding on permissible ways to deal with uncertainty.

By applying the scientific literature examining boundary organizations in the context of the judicial system, we will demonstrate the ways in which the courts fit into this theoretical framework. Reviewing the path of the litigation regarding the delta smelt fish situates this analysis within the actual workings of the trial and appellate courts. By evaluating the series of decisions

Leeuwis, *Delegation of Authority in Research Funding to Networks: Experiences with a Multiple Goal Boundary Organization*, 35 SCI. & PUBLIC POL'Y 183–196 (2008).

27. Tennessee Valley Authority v. Hill, 437 U.S. 153, 172–73 (1978) ("It may seem curious to some that the survival of a relatively small number of three-inch fish . . . would require the permanent halting of a virtually completed dam," however, "the explicit provisions of the Endangered Species Act require precisely that result.").

28. "The law embodies the story of a nation's development through many centuries, and it cannot be dealt with as if it contained only the axioms and corollaries of a book of mathematics." OLIVER WENDELL HOLMES, JR., SELECTIONS FROM THE COMMON LAW, *in* THE MIND AND FAITH OF JUSTICE HOLMES: HIS SPEECHES, ESSAYS, LETTERS AND JUDICIAL OPINIONS 52 (Max Lerner ed., 1946).

29. Louis D. Brandeis, *The Living Law*, 10 ILL. L. REV. 461, 464 (1916) (noting that "legal science" is not always as quick as other sciences (*e.g.*, economics and sociology) to adapt to changing conditions); *cf.* E. P. THOMPSON, WHIGS AND HUNTERS: THE ORIGINS OF THE BLACK ACT 250 (1975) (arguing that law is collective, influenced by forces outside of itself, "[t]he greatest of all legal fictions is that the law itself evolves, from case to case, by its own impartial logic, true only to its own integrity, unswayed by expedient considerations").

regarding the type and quality of scientific research to be completed and to be considered during the proceedings themselves, the courts act as major components in the production and certification of science. The mechanisms of appellate review further shape the science; however, the seminal role of the district court receives special scrutiny in order to examine how a trial court navigates through contested technical issues.

Part II of this article turns back to social science and science-and-technology studies to consider what potential lessons on process and stakeholder engagement litigation and courts can offer to other transdisciplinary methods and boundary organizations. We highlight those related to three aspects of the delta smelt litigation: (1) constraints that are mediated by consideration of broader social-ecological contexts, e.g., who can be involved, what evidence considered, and how; (2) levels of review and predetermined levels of scrutiny; and (3) built in mechanisms for adaptation (learning and changing approaches). Finally, we conclude by suggesting areas of future research, such as in comparative reviews of judicially guided production of scientific research, as well as how such actions by lower courts affect reversal rates by appellate courts.

II. In What Ways can Courts be Considered Boundary Organizations?

Common law courts have, partly by default, become major arenas for science-informed decision-making, especially for cases in which priorities and values conflict. This is common in cases of complex litigation over water rights, land use development, and endangered species protection.[30] Courts are boundary organizations for at least two reasons. First, they are policymaking bodies that use science to inform conflict resolution and clarify rules for human-environment interaction. As part of this aspect, courts include multiple mechanisms and rules for stakeholder involvement and inclusion of scientific evidence. Second, they engage in directing the course of scientific research.

Political science professor David H. Guston argues that while boundary organizations, which blur the line between science and policy, are useful to

30. D. C. McKinley et al., *When Peer-Reviewed Publications are not Enough! Delivering Science for Natural Resource Management*, 21 FOREST POL'Y AND ECON. 1, 2 (2012) ("Discussion on America's land ethic continues to this day and will certainly continue to evolve. Often this discussion is expressed in the judicial system by groups wanting to suspend forest management activities that are perceived to not be aligned with their view of a land ethic.").

scientists, they can also lead to better policymaking.[31] According to Guston, boundary organizations have three characteristics: (1) they provide a means to create and use boundary objects; (2) they involve participation from scientists and non-scientists; and (3) they straddle the line between politics and science, while remaining accountable to both.[32]

As the delta smelt case study below illustrates, courts and lawsuits involving questions of science are, by definition and function, boundary organizations. The courts' rulings can be viewed as boundary objects created and utilized in the process of litigation. Courts sit on the line between politics, policy making, and science. The question of accountability is the most problematic for courts as boundary organizations. While considered to be independent, judges are accountable for their decisions and can be overturned by appellate courts. Whether courts, and judges in particular, are actually accountable to the scientific community for their decisions on science issues is a question for further study.

A. Courts as Policy-Makers

Courts can be considered boundary organizations because they are still part of the political landscape.[33] Even judicial selection is political in nature—whether the judges are appointed by the executive branch and confirmed by the legislator (as in multiple states and at the federal level) or whether judgeships operate under Jacksonian-era conventions, subject to direct election by the voters (as in several other states). In either instance, courts are boundary organizations in that they are compelled to interpret science findings in the broader politically charged context of social disputes.

Courts are political actors in that they serve political functions (e.g., resolving disputes, legitimizing government) and create policy through

31. David H. Guston, *Boundary Organizations in Environmental Policy and Science: An Introduction*, 26 SCI. TECH. AND HUM. VALUES 399 (2001).

32. *Id.* at 401.

33. *See, e.g.*, Carl Bauer, *Slippery Water Rights: Multiple Water Uses and the Neoliberal Model in Chile, 1981–1995*, 38 NAT. RES. J. 109 (1998); *cf.* CARL BAUER, SIREN SONG: CHILEAN WATER LAW AS A MODEL FOR INTERNATIONAL REFORM (2004) (discussing in part the failure of Chilean courts to fulfill their political function in resolving water disputes); *see also* MORTON HORWITZ, THE TRANSFORMATION OF AMERICAN LAW, 1870–1960 (1992) (writing about the long trend, at least in the United States, of moving away from a concept of law as autonomous or "a 'science' that could be separate from politics . . . sharply distinguished from moral or political reasoning").

judicial review and dispute resolution.[34] Courts however are unlike other political actors in terms of how they are constrained in their abilities to exercise power.[35] Comparative law scholar Martin Shapiro notes that "courts tend to be loaded with multiple political functions . . . from bolstering the legitimacy of the political regime to allocating scarce economic resources or setting major social policies."[36] But, the primary function of courts is still dispute resolution,[37] which along with the requirements of standing[38] and a tradition of promoting the perception of judicial independence,[39] constrain the ability of courts to exercise power.

These constraints do not remove courts from the policy realm. The requirements of standing and the adversarial nature of the disputes heard by courts actually make the dispute resolution function of courts inherently political. For example, because of the standing requirements, legally relevant knowledge tends to be interest-laden, such that "the choice between alternative . . . accounts necessarily involves normative, even political judgments."[40] In this way, courts are part of the policymaking process.[41] The legal constraints that courts and judges abide by therefore produce policy or rules that are primarily applicable to the dispute being heard. But in doing so, courts still create broader policy consequences, applicable beyond the disputants.

Particularly in regard to questions of law, such as a motion for summary judgment, judges apply legal reasoning to examine the sufficiency of the detailed scientific research proffered by litigants as evidence. By permitting certain research models or particular scientific experts to be allowed into court proceedings, the judge establishes and polices the boundary delineating legally sanctioned science. In addition, since even

34. *See generally* HERBERT JACOB ET AL., COURTS LAW & POLITICS 16–80 (2000).

35. *See generally* MARTIN SHAPIRO, COURTS, A COMPARATIVE AND POLITICAL ANALYSIS (1981).

36. *Id*. at 63.

37. JACOB, *supra* note 34, 16–80.

38. *See, e.g.*, Daniel Ho & and Erica Ross, *Did Liberal Justices Invent the Standing Doctrine—An Empirical Study on the Evolution of Standing*, 1921–2006, 62 STAN. L. REV. 591 (2010).

39. *See, e.g.*, THEODORE L. BECKER, COMPARATIVE JUDICIAL POLITICS: THE POLITICAL FUNCTIONING OF COURTS 140–161 (1970).

40. SHEILA JASANOFF, SCIENCE AT THE BAR: LAW, SCIENCE, AND TECHNOLOGY IN AMERICA 209 (1995).

41. *See generally* JACOB, *supra* note 34.

"good" science may be deemed irrelevant to the issues in question, the judge's role as gatekeeper in regard to admissibility of evidence will act to shape the contours of the litigation.

These decisions can have far-felt impacts beyond the instant case. Since the judicial system in the United States operates under the principle of *stare decisis*, a line of precedent can be established on appellate review of a lower court's ruling on evidence of a scientific nature that could be followed indefinitely into the future. Further, while one district court's rulings are not binding on other courts, they are persuasive and can become influential as models for handling novel scientific arguments—i.e., legitimizing certain scientific approaches over others.

The political nature of courts comes to the fore in cases where science is in dispute. As science, technology, and society ("STS") studies demonstrate, a court's adoption of science can also lead to the science's validation in other areas, such as policymaking.[42] In their case study of the Klamath Basin conflict, Dan Tarlock and Holly Doremus describe how litigants used scientific studies to strengthen their water rights claims.[43] Because the underlying rights claims conflicted, so too did the scientific conclusions the litigants used to support their claims. Tarlock and Doremus describe this phenomenon as "combat biology."[44] When courts decide disputes involving combat biology, and "combat science" generally, they implicitly—and occasionally, explicitly—legitimize the science, and sources of science, used by the victors.[45] In this way, courts can be particularly influential science filters for policy decisions.

42. *See, e.g.*, David S. Caudill, *Law, Science, and Science Studies: Contrasting the Deposition of a Scientific Expert with Ethnographic Studies of Scientific Practice*, 12 S. CAL. INTERDISC. L.J. 85 (2002); MARIANA VALVERDE, LAW'S DREAM OF A COMMON KNOWLEDGE (2003).

43. HOLLY DOREMUS & A. DAN TARLOCK, WATER WAR IN THE KLAMATH BASIN: MACHO LAW, COMBAT BIOLOGY, AND DIRTY POLITICS 11–13 (2007).

44. *Id.* at xvii.

45. *See generally* JASANOFF, *supra* note 40; *see also* Steven Shapin, *Cordelia's Love: Credibility and the Social Studies of Science*, 3 PERSP. ON SCI. 255 (1995).

B. Gatekeepers and Directors of Science—The Delta Smelt Consolidated Cases

The underlying tension in the legal disputes over the delta smelt is not the fish itself, but longstanding conflicts over water allocation priority in California. The delta smelt's status as a threatened and now endangered species brought these tensions to the forefront. The delta smelt (H*ypomesus transpacificus*) is a small fish, averaging under three inches in length, endemic to California. While diminutive in size, the fish plays an important part in the delta ecosystem and it has received special recognition as "the only true native estuarine species found in the [Sacramento-San Joaquin] Delta."[46] In 1993, in recognition of critical declines in population and challenges to fish habitat, the United States Fish and Wildlife Service ("FWS") issued a final rule listing the delta smelt as threatened under the federal Endangered Species Act.[47]

The natural habitat of the delta smelt is affected by two large water diversion projects, the Central Valley Project ("CVP") and the State Water Project ("SWP").[48] The projects redirect the flows of the Sacramento and San Joaquin rivers from their confluence at the Bay-Delta through two pumping stations at the south of the delta to irrigate farms in the Central Valley and provide water to California's urban southern coast.[49] The listing of the smelt under the Endangered Species Act required the Bureau of Reclamation to consult with the FWS to determine whether and how operation of the CVP negatively affected delta smelt.[50] This is a deceptively difficult question, because the multiple interdependencies of the smelt's habitat are not wholly known; and in studying questions related to delta smelt health and habitat, researchers have to work within considerable uncertainties.[51] But adjustments to the projects could affect the timing and amount of water delivered to contractors who have come to expect and depend on water deliveries.

46. Endangered and Threatened Wildlife and Plants; Determination of Threatened Status for the Delta Smelt, 58 Fed. Reg. 12854 (Mar. 5, 1993) [hereinafter Delta Smelt Endangerment Finding].

47. I*d*.

48. The United States Bureau of Reclamation operates the CVP and the state of California operates the SWP.

49. DAVID CARLE, INTRODUCTION TO WATER IN CALIFORNIA 92–104 (2004).

50. 16 U.S.C. § 1536(a)(2) (2011).

51. S*ee*, *e.g.*, Delta smelt (Hypomesus transpacificus), U.S. FISH AND WILDLIFE SERVICE, http://ecos.fws.gov/speciesProfile/profile/ speciesProfile.action?spcode=E070 (last visited Feb. 28, 2015); *see also* Delta Smelt Endangerment Finding, *supra* note 46.

Thus, when the delta smelt was listed, it set into motion a long and contentious series of legal battles among federal authorities, state agencies in California, nonprofit advocacy groups, water management authorities, and farmers, among others, over potential management plans for the delta smelt and the far-reaching consequences of these plans on water resources for over half the state of California. As an example of the remarkable geographic extent of this complex legal entanglement, the Metropolitan Water District of Southern California, which relies on substantial freshwater interbasin transfers from the river system associated with the delta to provide drinking water to nearly seventeen million residents in and around Los Angeles and San Diego,[52] is a party to the litigation.[53]

The case study for this article involves a series of cases brought by different parties, which were consolidated for their central nexus involving the delta smelt, and later appealed to the United States Court of Appeals for the Ninth Circuit.[54] This is only one of five fully consolidated suits that relate to operations of the CVP, SWP, and endangered species.[55] All sides involved in this protracted struggle have called upon science to bolster their respective arguments and proposals, as well as in an attempt to undermine the positions of other participants. Given the extensive requirements of the ESA regarding the protection afforded to listed species and the very substantial financial costs associated with the different variants of the management plans, a multitude of scientific reports have been commissioned to study the delta smelt and impacts on its habitat.[56] Litigants relied on scientists to review and critique the studies of adversarial parties.

52. DAVID CARLE, INTRODUCTION TO WATER IN CALIFORNIA 92–104 (2004).

53. San Luis & Delta-Mendota Water Authority v. Salazar (*Delta Smelt Consolidated Cases* I), 760 F. Supp. 2d 855, 863 (E.D. Cal. 2010).

54. *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d 855, *aff'd in part, rev'd in part sub nom.*, San Luis & Delta-Mendota Water Auth. v. Jewell, 747 F.3d 581 (9th Cir. 2014), *cert. denied sub nom.*, Stewart & Jasper Orchard v. Jarwell, No. 14-377, 2015 WL 132972, at *1 (U.S. Jan. 12, 2015), *and* State Water Contractors v. Jarwell, No. 14-402, 2015 WL 132973, at *1 (U.S. Jan. 12, 2015).

55. San Luis & Delta-Mendota Water Auth. v. Jewell (*Delta Smelt Consolidated Cases* II), 747 F.3d at 601.

56. *See, e.g.*, US FISH AND WILDLIFE SERVICE, BIOLOGICAL OPINION FOR THE DELTA SMELT (2008), http://www.fws.gov/sfbaydelta/documents/swp-cvp_ops_bo_12-15_final_ocr.pdf [hereinafter FWS BiOp 2008]; SCOTT MCKINLEY ET AL., SCIENCE REVIEW OF TESTIMONY IN THE DELTA SMELT CASES: SUMMARY REPORT (2011), http://www.resolv.org/wp-content/uploads/2011/02/Delta-Smelt-Summary-Report-Final-3-redacted-3.pdf.

1. History of the Dispute

Of the many court cases in the "continuing war over protection of the delta smelt"[57] we focus only on two here, the federal district court opinion, written by Judge Oliver W. Wanger, in *San Luis and Delta-Mendota Water Authority v. Salazar* (*Delta Smelt Consolidated Cases* I), 760 F. Supp. 2d 855 (E.D. Cal. 2010), and the divided Ninth Circuit panel opinion reviewing that case, *San Luis and Delta Water Authority v. Jewell* (*Delta Smelt Consolidated Cases* II), 747 F.3d 581 (9th Cir. 2014). At issue in these cases was a FWS Biological Opinion ("BiOp") issued on December 15, 2008, described as "the most complex biological opinion ever prepared."[58] Since the initial listing of the smelt as a threatened species in 1993, actions taken to protect the fish proved unable to prevent fish populations from continuing to shrink.[59] The 2008 BiOp attempted to answer whether continued operation of the CVP would jeopardize the smelt and found that the continued operations would jeopardize the smelt's habitat.[60] The district court found that conclusion to be arbitrary and capricious.[61] The court of appeals disagreed and reversed.[62]

57. *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d at 863.

58. *Delta Smelt Consolidated Cases* II, 747 F.3d at 592.

59. *See* FWS BiOp 2008, *supra* note 56, at 140.

60. *See* FWS BiOp 2008, *supra* note 56, at 276–79; *see also Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d at 864.

61. *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d at 968–70. Under the Administrative Procedure Act ("APA"), administrative agency decisions, such the 2008 BiOp conclusion regarding harm to the delta smelt, are reviewed under the arbitrary and capricious standard. 5 U.S.C. § 706 (2011) ("The reviewing court shall . . . hold unlawful and set aside agency action, findings, and conclusions found to be . . . *arbitrary*, *capricious*, an abuse of discretion, or otherwise not in accordance with law . . . ." (emphasis added)). An agency's decision is "arbitrary and capricious if [it] 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." *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d at 869 (citing Motor Vehicle Mfrs. Ass'n of U.S., Inc. v. State Farm Mut. Auto. Ins. Co., 463 U.S. 29, 43 (1983)); *see also* Citizens to Preserve Overton Park, Inc. v. Volpe, 401 U.S. 402, 416 (1971) (holding that a reviewing court may overturn an agency's action as arbitrary and capricious if the agency failed to consider relevant factors, failed to base its decision on those factors, and/or made a "clear error of judgment").

62. *Delta Smelt Consolidated Cases* II, 747 F.3d at 592.

The FWS found four significant threats to the future viability of the species existed in the delta: (1) direct entrainments by state and federal water export facilities;[63] (2) summer and fall increases in salinity;[64] (3) summer and fall increases in water clarity;[65] and (4) effects from introduced species.[66] The BiOp, as part of the Long-Term Operational Criteria and Plan, examined the manner in which operations of the federally managed CVP and SWP influenced the life cycle of the delta smelt.[67] In the analysis of the BiOp, cooperative management of these two major water projects under existing practices would be "likely to jeopardize the continued existence of the delta smelt and adversely modify its critical habitat."[68] As part of a separate five-year review of the status of the delta smelt population, FWS concluded that new scientific evidence supported a heightened listing of the smelt from threatened to endangered, although FWS admitted that other higher-priority issues prevented the rapid initiation of such listing procedures.[69]

Due to the conclusions of the BiOp, the FWS issued a required "Reasonable and Prudent Alternative" ("RPA") to prescribe actions necessary to protect the delta smelt, while allowing for a partial continuance of existing water project management practices.[70] The RPA recommended that the operation of CVP and SWP be substantially altered through the imposition of restrictions on pumping at different times of the year when certain water levels and salinity levels in the Sacramento-San Joaquin Delta were deemed to be crucial for the protection of the delta smelt.[71]

63. FWS BiOp 2008, *supra* note 56, at 164–165.

64. I*d*. at 187.

65. I*d*. at 150.

66. I*d*. at 202.

67. S*ee id*. at 159–78.

68. *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d 855, 864 (E.D. Cal. 2010).

69. Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition to Reclassify the Delta Smelt From Threatened to Endangered Throughout Its Range, 75 Fed. Reg. 17667 (April 7, 2010).

70. S*ee* FWS BiOp 2008, *supra* note 56, at 279.

71. S*ee id*. at 280.

The Bureau of Reclamation implemented some of the restrictions during a preliminary review period. As a result, water supplies were notably curtailed to various irrigation districts and urban water districts.[72] These curtailments were seen as substantial threats to the economics of the status quo operations of these entities.[73] As a result, several of these affected parties entered the legal proceedings and sued the FWS and Bureau of Reclamation, challenging the scientific bases for both the conclusions made in the BiOp and the proposed actions grounded in those conclusions.[74]

Over six hundred documents, many of them offering or challenging scientific "claims" offered by experts, were filed with the U.S. District Court for the Eastern District of California leading up to the December 14, 2010 decision. Various plaintiffs filed motions for summary judgment, with similar counter-claims issued by defendants.[75] As stated by the district court, "summary judgment becomes the 'mechanism for deciding, as a matter of law, whether the agency action is supported by the administrative record [AR] and otherwise consistent with the APA standard of review.'"[76]

2. District Court's Role in Defining Relevant and Legitimate Science

The district court was asked to address a difficult problem. Judge Wanger's expression of the limits of the law to truly resolve water allocation in California belies the wickedness of the problem:

> A court is bound by law. Resource allocation and establishing legislative priorities protecting the environment are the prerogatives of other branches of government. *The law alone cannot afford protection to all the competing interests at stake in these cases*.[77]

72. Daniel B. Wood, *Water Crises Squeezes California's Economy*, CHRISTIAN SCI. MONITOR, Sept. 12, 2007, http://www.csmonitor.com/2007/0912/p02s01-ussc.html; Peter Fimrite, *Ruling to Protect Delta Smelt May Force Water Rationing in Bay Area*, S.F. CHRON., Sept. 1, 2007, http://www.sfgate.com/bayarea/article/Ruling-to-protect-delta-smelt-may-force-water-2506504.php.

73. *See* Wood, *supra* note 72; Fimrite, *supra* note 72.

74. *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d 855, 863–67 (E.D. Cal. 2010).

75. *Id*.

76. *Id*. at 868.

77. *Id*. at 968 (emphasis added).

There has been no resolution to the underlying conflicts in water allocation between the smelt and competing water needs. It cannot be tackled as a simple problem to which science would have an answer.[78] Nonetheless, all parties in the case relied on science to support their legal claims.

The district court became the battleground for the use of "combat science" in determining the sufficiency of the FWS's documentation and research in its administrative record for the recommended actions aimed at protecting the delta smelt and its estuarine habitat. In resolving the dispute—at least on summary judgment—and weighing competing expert testimony, the court assumed the role of a boundary organization. It sorted through the voluminous filings and applied judicial principles, statutory requirements, and administrative regulations to determine which parties can participate, what types of science would be admitted, how much deference should be accorded to FWS-sponsored studies, and—ultimately—whose scientific research would be adjudged most determinative in the proceedings.

The district court noted that the recommended actions issued by the FWS, under the auspices of the ESA, were required to be based on the "best scientific and commercial data available."[79] The question of whether any scientific data is "best" is contestable. Scientific communities may have their own standards to judge what is considered to be "best" data.[80] However, in litigation, courts determine what qualifies as the "best scientific and commercial data available." There are nonetheless prescribed guidelines for judges to use to determine whether scientific data is acceptable or not to guide FWS actions.[81] These guidelines tend to turn on whether the agency acted in an arbitrary or capricious manner (i.e., if the connection between the data and the action is reasonably related)[82] and whether there are "unrebutted expert opinions" to the contrary.[83]

If the district court determined that the FWS had failed to employ the best available science, as required, the agency's final rule would be considered arbitrary and capricious and remanded to the agency for further

78. *See* Rittel & Webber, *supra* note 6.

79. *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d at 870–71 (citing 16 U.S.C. § 1536(a)(2); 50 C.F.R. § 402.14(g)(8)) (2009).

80. *See generally* BRUNO LATOUR & STEVE WOOLGAR, LABORATORY LIFE: THE CONSTRUCTION OF SCIENTIFIC FACTS (1979).

81. For examples of statutory requirements regarding when this standard is mandated, see 16 U.S.C. §§ 1533(b)(1)(A), (b)(2), 1536(a)(2), (c) (2011).

82. Greenpeace v. NMFS, 80 F. Supp. 2d 1137, 1147 (W.D. Wash. 2000).

83. N. Spotted Owl v. Hodel, 716 F. Supp. 479, 483 (W.D. Wash. 1988).

study.[84] Judge Wanger weighed two main aspects of science in the *Delta Smelt Consolidated Cases* I decision: (1) the reasonableness and rigor of the science itself; and (2) whether the science used in the case supported the policy actions of the agencies in question. Together these formed the basis for judging "best available science."

The district court's 225-page decision engaged in a detailed review of whether FWS used the best available science in the BiOp. Plaintiffs assailed several elements of FWS's methodology in preparing the BiOp. While declines in the numbers of smelt provided the basis for much of the reasoning in the BiOp, the plaintiffs criticized the FWS's methods for conducting smelt populations censuses and determining anthropogenic influences on smelt habitat, smelt breeding, and survival rates.[85] For example, FWS relied on "raw salvage figures" for calculating certain water release/flow limits, without accounting for normalizing of these numbers, as was standard practice among fishery scientists.[86] Further, certain measuring practices were followed in some instances, but not others, with no explanation as to the variance.[87] In yet other situations, conclusions were reached with very little justification in the administrative record to detail the how or why of such reasoning.[88] Arguments also centered on the alleged flaws in modeling, or in the inappropriate comparison of data across incompatible computer models.[89]

The district court reviewed testimony from experts in each field before deciding whether the FWS had incorporated acceptable science into the administrative record to support the BiOp.[90] Additionally, the district court admitted two expert reports into evidence that were not part of the administrative record.[91] Considering outside relevant scientific evidence is allowed both through tradition[92] and through Federal Rule of Evidence 706, which permits the court to "appoint any expert that the parties agree on and

84. *See* Earth Island Inst. v. Hogarth, 494 F.3d 757, 770 (9th Cir. 2007) ("the ordinary remedy when a court finds an agency's action to be arbitrary and capricious is to remand for further administrative proceedings").

85. *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d 855, 881 (E.D. Cal. 2010).

86. *Id*. at 889.

87. *See id*. at 885–90.

88. *See id*. at 946–47

89. *See id*. at 903–13, 920–22.

90. *See*, *e.g.*, *id*. at 869–947.

91. *See id*. at 883, 890.

92. Brandeis, *supra* note 29.

any of its own choosing."[93] Judge Wanger appointed Doctors Punt and Quinn, both from the University of Washington, to advise on the scientific and technical aspects of the case, and relied substantially on their testimony.[94]

In its conclusion, the district court took the FWS to task for its use of "results driven"-"bad science" in creating the BiOp, stating that "the public cannot afford sloppy science."[95] As a result, the FWS and its scientists were dealt several judicial setbacks. The district court also ruled in favor of the plaintiffs regarding the failure to meet a four-part test for evaluation of the RPA, stating:

> [The] FWS has shown no inclination to fully and honestly address water supply needs beyond the species, despite the fact that its own regulation requires such consideration. . . . How the appropriation of water for the RPA Actions, to the exclusion of implementing less harmful alternatives, is required for species survival is not explained. The appropriate remedy for such a failure is remand to the agency.[96]

93. Fed. R. Evid. 706(a).

94. The Ninth Circuit expressed concern over the district court's allowance of evidence beyond the administrative record. *See Delta Smelt Consolidated Cases* II, 747 F.3d 581, 603 (9th Cir. 2014) (describing the district court proceedings as "giv[ing] the appearance that the administrative record was open and that the proceedings were a forum for debating the merits of the BiOp"); *see also id*. at 604 ("Because we review the court's judgment *de novo*, however, we can confine our own scope of review to the administrative record, plus that evidence that satisfies the standards we have set forth here."). However, it is still important to note that Judge Wanger's decision to admit the extra-record evidence demonstrates the way trial courts can influence the social construction of scientific knowledge. Further research is required to understand the frequency with which trial judges proactively avail themselves of such experts and how such actions may affect the outcomes of trials—as well as contribute to persuasive new forms of scientific knowledge.

95. *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d at 968.

96. *Id*. at 957. The Ninth Circuit disagreed with the district court's conclusion that the FWS failed to explain why it chose the RPAs. *See Delta Smelt Consolidated Cases* II, 747 F.2d at 635–38 (concluding that "FWS's consideration of [the RPA factors] may be reasonably discerned from the record to satisfy any explanation requirements"). As similarly stated *infra* Part B.2, this article does not focus on the Ninth Circuit's disapproval of the district court. Instead, we focus on how a district court's actions can influence the social construction of "science."

The court still upheld the FWS's determination on several key issues, finding alternately either that "best available science" was appropriately documented in the administrative record or that the science offered was not so insufficient and suspect as to compel the court to remand for additional examination.[97] For example, while a quantitative life cycle model would be considered a "top-of-the-line" method among fishery scientists for understanding the impacts of water project management on the delta smelt, alternate population study methods were considered sufficient to the extent that they "did not per se violate the ESA or the APA," especially given that a model specifically designed for smelt had not yet been created.[98] Looking at existing precedent, the court ruled that the "best available science" standard hinged on the existing and available science, not on "best science possible."[99] While such district court decisions can receive unfavorable treatment from appellate courts (including in this case), the *Delta Smelt Consolidated Cases* still highlight the powerful role filled by district courts, as they are on the front lines and required to make these determinations in the absence of clear guidance from statutes, regulations, or precedent.

Within the context of science and decision-making under the ESA, courts choose between competing scientific claims that underlie the BiOp. In doing so, a court's actions in evaluating the value-laden scientific products will ultimately shape and direct public policy—i.e., preventing the extinction of endangered species, fulfilling legal contracts for water, and so forth. *Delta Smelt Consolidated Cases* I stands for the idea that the court is required to make judgments on the caliber of the science used by agencies to support their decisions—i.e., a nonscience organization passing judgment on whether science used for policymaking is up to adequate standards. As arbiter of both the dispute and the science, the district court is a critically important boundary organization.

C. Beyond Gate-Keeping: Courts as Science Managers

A closer analysis of the processes leading up to Judge Wanger's decision and the additional review by the court of appeals demonstrates that courts, as boundary organizations, can also be instrumental in directing the course of science. There are at least two ways in which the district and appellate courts in this case directed the course of scientific production relating to process (e.g., setting the timeline for research) and substance

97. *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d at 968–70.

98. *Id.* at 885.

99. *Id.*

(e.g., defining ecological thresholds and deciding on permissible ways to deal with uncertainty).

While the FWS drafted the 2008 FWS BiOp, the court also played a substantial role in its development. By controlling the amount of time that FWS had to complete the BiOp, the district court affected the final form of the BiOp and FWS's choice of methodologies to complete the document within the limited time frame.[100]

Prior to the 2008 BiOp, the FWS had issued a 2005 BiOp on a similar topic.[101] The 2005 BiOp concluded that the operations of the CVP and SWP "would *not* have an adverse effect on the continued existence and recovery of the delta smelt and its critical habitat."[102] In *Natural Resources Defense Council v. Kempthorne*, the district court found the 2005 BiOp to be arbitrary and capricious.[103] After an extensive evidentiary hearing, the *Kempthorne* court required the CVP and SWP to release winter pulse flows within a specific cubic feet per second ("cfs") range.[104] That order was intended to be a bridge measure, while the FWS completed a new BiOp based on the findings of fact and law from the earlier dispute.[105] The district court gave the FWS a strict deadline of only nine months to complete the new BiOp.[106]

The product of that nine-month rush was the 2008 BiOp, which was the focus in *Delta Smelt Consolidated Cases* I. Not surprisingly, given the quick court-mandated turn around, the 2008 BiOp was less than perfect. The court of appeals noted that the BiOp was "at more than 400 pages, a big bit of a mess. And the FWS knew it."[107] It "appear[ed] to be the result of exactly what we would imagine happens when an agency is ordered to produce an important opinion on an extremely complicated and technical subject matter covering multiple federal and state agencies and affecting millions of acres of land and tens of millions of people" and only given nine months to complete it.[108] Deadlines of that kind "become a substantive constraint on

100. *See Delta Smelt Consolidated Cases* II, 747 F.3d at 605–06 (discussing how the tight court ordered deadline lead to a "jumbled" and "chaotic" document).

101. *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d at 863.

102. *Delta Smelt Consolidated Cases* II, 747 F.3d at 597 (citing *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d at 863).

103. *Kempthorne*, 506 F. Supp. 2d 322, 387–88 (E.D. Cal. 2007).

104. *Delta Smelt Consolidated Cases* II, 747 F.3d at 597.

105. *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d at 863 & n.1.

106. *Delta Smelt Consolidated Cases* II, 747 F.3d at 605 & n.15.

107. *Id.* at 604.

108. *Id.* at 605.

what an agency can reasonably do."[109] The deadline for the 2008 BiOp was not determined by the FWS but "by the same district court that would later hold the FWS's rushed BiOp as arbitrary and capricious."[110]

Interactions with earlier district court orders also played a role in determining certain ecological thresholds, specifically the appropriate cap of reverse flows from the delta. While the *Kempthorne* court found the 2005 BiOp to be arbitrary and capricious,[111] the court's order, which set a 5,000 cfs cap on reverse flows from the CVP and SWP, greatly influenced the FWS's 2008 BiOp.[112] Although the 5,000 cfs cap was intended as a stop gap measure, the FWS relied on the court's order and the studies which the court relied on when setting the reverse flow threshold in its 2008 BiOp.[113] The Ninth Circuit noted: "FWS can hardly be faulted for thinking that the district court's acceptance of those studies and the issuing of an order with real-world consequences for people and smelt might present at least a *prima facie* case for the –5,000 cfs figure."[114]

The Ninth Circuit decision was also instructive on deciding permissible ways to deal with scientific uncertainty. Throughout the opinion, the panel reiterated that the ESA's "best available science" standard does not equate with perfect knowledge.[115] The range of acceptable uncertainty is quite broad and the agency has discretion to lean on the scales in favor of conservative estimates.[116] For example:

109. *Id*. at 606.

110. *Id*. at 605.

111. Natural Res. Def. Council v. Kempthorne, 506 F. Supp. 2d 322, 387–88 (E.D. Cal. 2007).

112. *Delta Smelt Consolidated Cases* II, 747 F.3d at 608–14; *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d 855, 863–64 (E.D. Cal. 2010) (setting a cap of 5,000 cfs).

113. *Delta Smelt Consolidated Cases* II, 747 F.3d at 614.

114. *Id*.

115. *Id*. at 602 (citing Kern County Farm Bureau v. Allen, 450 F.3d 1072, 1080–81 (9th Cir. 2006) ("Absent superior data[,] occasional imperfections do not violate the ESA best available standard." (internal quotations omitted)); *see also id*. ("[W]here the information is not readily available, we cannot insist on perfection"); *id*. (quoting Envtl. Def. Ctr., Inc. v. U.S. E.P.A., 344 F.3d 832, 872 (9th Cir. 2003) ("We defer to an agency decision not to invest the resource necessary to conduct the perfect study, and we defer to a decision to use the means [the FWS] use[d] to account for any imperfections in its data and the situation to which those means are applied.")).

116. *See*, *e.g.*, *id*. at 608.

> [T]he Supreme Court has held that an agency may choose to "counteract uncertainties" inherent in its scientific analyses by "overestimat[ing]" known parameters without being unreasonable and we have upheld an agency's reliance on models that "yield conservative data because the models incorporate the higher of [known potential values] in assessing the overall risk."[117]

In other words, despite the rational management language of the ESA, the interpretation of courts overseeing ESA disputes recognize that uncertainty happens and may not always be overcome even in the best of circumstances.[118] Instead of demanding "best possible" science, the courts are deferential to agency discretion in matters of scientific uncertainty.

II. Lessons for Other Boundary Organizations

The district court in *Delta Smelt Consolidated Cases* I overreached in its reliance on outside experts and willingness to decide on the validity and quality of scientific methodologies and conclusions. The Ninth Circuit disapproved of this "open record" approach:

> In places, the district court pits the experts against each other and resolves their contrary positions as a matter of scientific fact. In effect, the district court opened the BiOp to a post-hoc notice-and-comment proceeding involving the parties' experts, and then judged the BiOp against the comments received.[119]

Furthermore, the district court "relied on experts as advocates for the basis of rejecting the BiOp."[120] In short, science became the language of conflict.

Combat science, however, is not unique to the courtroom. Other boundary organizations that deal with wicked problems likewise must deal with conflicting expert opinions as proxies for conflicting values and grapple with the need to devise and implement policies and adaptive management plans in spite of the fray.[121] Lengthy environmental litigation, like the delta smelt case, offers some lessons to other boundary organizations. We do not

117. *Id.* at 610 (citation omitted).

118. *See, e.g.*, Doremus, *supra* note 5.

119. *Delta Smelt Consolidated Cases* II, 747 F.3d at 604 (citations omitted).

120. *Id.*

121. *See, e.g.*, Doremus, *supra* note 5, at 1460, 1462–67.

suggest that the common law or the federal bench has the problem of combat science and stakeholder participation processes completely worked out. Judge Wanger's decision demonstrates quite the opposite. We suggest that the courts have been dealing with problems of conflicting testimony and competing values for a long time and thus have developed mechanisms to balance values and concepts of equity against opposing scientific claims and the needs of society.[122] We posit that aspects of these mechanisms could be useful to other organizations as lessons for bridging science and policy.

In this section we focus on three procedural mechanisms that were decisive in determining which science prevailed under what conditions. The first is constraints on evidence and participation. These processes determine who can be involved, what evidence can be considered, and in what way. The second mechanism is predetermined levels of review. This includes levels of scrutiny that are triggered by different conditions as well as appellate review. And the third mechanism is built-in means for adaptation, or ways to learn and change approaches. We discuss each of these below briefly in relationship to the delta smelt case.

A. Constraints on Involvement

Defining the limits of stakeholder involvement—who can be involved, when, to what extent—is an issue that many boundary organizations struggle with.[123] Who can be involved in legal disputes is determined through mechanisms such as the requirements of standing,[124] restrictions on amici briefs, and rules of evidence. Additionally, "[c]ourts have (at least in the absence of legislation to the contrary) inherent power to provide themselves with the instruments required for the performance of their duties,"[125] including appointing technical experts and fact-finding referees.[126] Standing requirements and the adversarial process also help to ensure that

122. *See generally* HORWITZ, *supra* note 33.

123. *See, e.g.*, Duncan C. McKinley et al., *When Peer-Reviewed Publications are Not Enough! Delivering Science for Natural Resource Management*, 21 FOREST POL'Y & ECON. 1 (2012).

124. In layman's terms, there must be an actual dispute with at least two opposing parties who directly benefit from or are harmed by the dispute in order for the court to hear the case.

125. *Ex parte* Peterson, 253 U.S. 300, 312 (1920).

126. *See* William Blomquist & Elinor Ostrom, *Deliberation, Learning, and Institutional Change: The Evolution of Institutions in Judicial Settings*, 19 CONST. POL. ECON. 180, 184 (2008).

the court is well briefed on all the arguments of the dispute at hand, an advantage over other policy institutions.[127]

Importantly, these constraints are moderated by measured flexibility. Courts for example *can* look outside the administrative record in a case, as the district court did in *Delta Smelt Consolidated Cases* I. This point was also stressed in the Ninth Circuit opinion as well as Judge Arnold's dissent.[128] Although courts maintain the flexibility to solicit and consider information external to the administrative record, that flexibility is mediated by specific requirements. These constraints include circumstances in which: "(1) supplementation is necessary to determine if the agency considered all factors and explained its decision; (2) the agency relied on documents not in the record; (3) supplementation is needed to explain in technical terms or complex subjects; or (4) plaintiffs have shown bad faith on the part of the agency."[129] In sum, courts cannot seek to expand administrative records without a clear justification.

The suite of constraints need not be adopted by all boundary organizations (nor could they necessarily). But it could be instructive to decide, prior to beginning research or bridging science and policy, rules that define the characteristics of who can be involved, when and to what extent they can be involved, *and* when those general rules can be broken.

B. Multiple Nested Levels of Review

Here we refer to both "standards of review" (i.e., how much deference the court gives to the agency) and the ability of district court decisions to be appealed and reviewed.

127. *Id.*; Susan Nunn & Helen Ingram, *Information, the Decision Forum, and Third Party Effects in Water Transfers*, 24 WATER RESOURCES RES. 473 (1988).

128. *See Delta Smelt Consolidated Cases* II, 747 F.3d 581, 656 (9th Cir. 2014) (concluding that Dr. Richard Deriso's declaration, which was outside the administrative record, was appropriately admitted: "this evidence fell within one of the narrow exceptions to the general rule against extra-record evidence, because it was necessary to explain technical terms or complex subject matter" (citation omitted)).

129. Fence Creek Cattle Co. v U.S. Forest Serv., 602 F.3d 1125, 1131 (9th Cir. 2010); *see also* Lands Council v. Powell, 395 F.3d 1019, 1030 (9th Cir. 2005).

A common question on stakeholder involvement in scientific production is how involved should stakeholders be in directing science. The concern is that while stakeholders may understand issues of conflicting values better and be the ultimate users of science products, they tend to not be experts.[130]

Courts face a similar position. Lawyers may generally be more comfortable than most at using the skill of other experts,[131] but that is not a substitute for expertise. The courts have dealt with that problem in part through standards of review, which determine how much deference a judge should give to an agency decision. The importance of arbitrary and capricious review in the context of addressing complex scientific matters, as well as *de novo* appellate review, can be found throughout Judge Baybee's Ninth Circuit opinion. The Ninth Circuit's treatment of FWS's choice of hydrological models is illustrative of this. In preparing the BiOp, the FWS chose to use two different hydrological models together (DAYFLOW and CALSIM II).[132] That choice, although problematic because FWS was using a historical model and future projection model that used different parameters and assumptions, is considered to be a "scientific determination."[133] When reviewing "scientific determinations" that "require[] a high level of technical expertise,"[134] courts are required to "generally be at [their] most deferential."[135] That level of deference determined what science was legally acceptable.

130. *See, e.g.*, P.J. SULLIVAN ET AL., DEFINING AND IMPLEMENTING BEST AVAILABLE SCIENCE FOR FISHERIES AND ENVIRONMENTAL SCIENCE, POLICY, AND MANAGEMENT 13–22 (2006), http://fisheries.org/docs/policy_science.pdf (last visited Feb 28, 2015).

131. As Willard Hurst opined, "[t]he lawyer is the expert whose skill it is to make social use of the experts in all other fields." Daniel Ernst, *Willard Hurst and the Administrative State: From Williams to Wisconsin*, 18 LAW AND HIST. REV. 1 (2000).

132. *Delta Smelt Consolidated Cases* II, 747 F.3d at 617.

133. *Id.* at 618 (quoting Baltimore Gas & Elec. Co., 462 U.S. 87, 103 (1983)).

134. *Id.* (quoting Marsh v. Ore. Natural Resources Council, 490 U.S. 360, 377 (1989)).

135. *Id.* at 602.

Under the arbitrary and capricious standard, "[a] court 'may reject an agency's choice of a scientific model only when the model bears *no rational relationship* to the characteristics of the data to which it is applied.'"[136] This standard provides a substantial amount of judicial deference to administrative agencies and their decisions—allowing the experts to remain the experts, rather than the court substituting its opinion.

While courts have taken on the mantle of boundary organizations in part by default, some of the tools used by the courts in adjudicating wicked problems involving scientific review may be adaptable for use by other boundary organizations. For example, other boundary organizations could use the idea of judicial review standards, scrutiny, and deference to decide how closely non-expert stakeholders control the scientific process.

C. Mechanisms for Adaptation and Learning

Finally, appellate review allows for some modicum of learning and adaptation. The numerous reviews of the 2005 BiOp and the 2008 BiOp, by the district courts and the Ninth Circuit, allowed for multiple eyes on the problem and monitoring to ensure that courts, as well as parties to the dispute, adhered to the agreed upon rules. It also allows for changes to both law[137] and science. Without appellate review, the resulting science-based rules for operating the CVP and SWP would have been remarkably different. Other boundary organizations could learn from this and consider building in mechanisms for review.

We should note that despite all of their procedural mechanisms to deal with science and stakeholders, courts are not necessarily ideal boundary organizations. As Guston discussed, one of the purposes of boundary organizations is to mollify both anxious natural scientists and aggravated political groups. He writes, "the boundary organization . . . gives both the producers and the consumers of research an opportunity to construct the boundary between their enterprises in a way favorable to their own perspectives."[138] To the scientists, the organization should support their research and demonstrate how it is valuable to policymaking outside of science.[139] And, to policymakers, the organization should assure them that

136. *Delta Smelt Consolidated Cases* I, 760 F. Supp. 2d 855, 908 (E.D. Cal. 2010) (emphasis added) (citing Nat'l Wildlife Fed'n v. EPA, 286 F.3d 554, 565 (D.C. Cir. 2002)).

137. The evolution of law is something thoroughly discussed in legal history, and for brevity's sake we decline to explore it again here.

138. Guston, *supra* note 31, at 405.

139. *Id.*

it is their goals that shape the science coming out of the organization.[140] This appeasement of both the science and policy realms is not something that courts are designed to do; nor is it necessarily something that courts should attempt to do. Nonetheless courts are forced into the position of being a boundary organization through sifting through science and applying it to unavoidable policy questions of a justiciable nature.

IV. Conclusion

> We do not realize how large a part of our law is open to reconsideration upon a slight change in habit of the public mind.
>
> ~Oliver Wendell Holmes, Jr.[141]

With the remarkable increase in Congressional requirements since the 1960s involving clean water, species protection, environmental reviews, hazardous waste management, and water management reprioritization, there has been an explosion in the amount of scientific research to inform and challenge the resulting administrative state. A resetting of legislative priorities, such as through the Central Valley Project Improvement Act,[142] which elevated the protection of fish and wildlife, as well as efforts aimed at restoration and mitigation, so as to be on par with more traditional goals of federal water projects, such as irrigation, domestic uses, and power generation, led to the reframing of the legal landscape. This type of reshuffling has resulted in increasing the role of the judicial system in balancing complex ecosystem functions with other societally important water and land use objectives.

We have argued that understanding the interface between scientific research and the creation and implementation of public policy is fundamental to informed decision-making in the management of complex and dynamic social-ecological systems. We have grounded this approach within the context of the historically rooted adversarial nature of the United States judicial system. More specifically, we have analyzed how courts function as policymakers, gatekeepers, and directors of scientific research. This paper demonstrated how these actions are manifested in such ways as through control over the admissibility of scientific research as evidence,

140. *Id.*

141. OLIVER WENDELL HOLMES, JR., THE PATH OF LAW (1897), *in* MIND AND FAITH OF JUSTICE HOLMES: HIS SPEECHES, ESSAYS, LETTERS AND JUDICIAL OPINIONS 180 (Max Lerner ed., 1946).

142. Central Valley Project Improvement Act of 1992, Pub. L. No. 102-575, §§ 3401–3412, 106 Stat. 4706 (1992).

evaluation of dueling experts in the contest of "combat science," the impact of *stare decisis*, the interpretation of ambiguous or outdated legislatively prescribed scientific standards, and the legitimization of different assessment methods proffered as science by opposing parties.

This paper explored the concept of courts as boundary organizations by examining a case study regarding the complex litigation surrounding federally mandated water allocation rules designed to protect the endangered delta smelt in California's Sacramento-San Joaquin Delta. The literature on boundary organizations was reviewed in the context of the *Delta Smelt Consolidated Cases* in order to examine the effectiveness of these legal arenas as such translational institutions. The case study demonstrates how courts have landed into this role by default when litigation erupts out of wicked problems of a combined social and ecological nature. By some measures this case represents an especially high profile example of courts as boundary organizations, with a trial court judge experienced in contested water law issues, critical appellate review of how the trial court evaluated scientific evidence, and a host of well-funded litigants backed by small armies of scientific experts in support of their claims. While not all of these elements are always present, these types of cases serve to demonstrate many of the strengths and weaknesses of courts in this intermediary function regarding the oversight and execution of public policy.

Courts have become a decisive forum by default for assessing the relative merits of scientific evidence in protracted litigation over such thorny issues. In the process, courts function as political institutions presiding over considerations of cultural mores, social-ecological values, and the allocation of scarce resources like water in the arid West. While courts may sometimes lag in their responsiveness to civic sentiment, they nonetheless must navigate through issues of public policy. Yet these conditions explain the context in which courts become boundary organizations, serving to negotiate relationships between science and society. By embracing complexity, accepting nonlinear trajectories in the production of scientific research, and appreciating the role of transdisciplinary research in responding to wicked problems, courts can employ their traditional tools in dispute resolution to tackle wicked problems through mechanisms not available to other institutions.

This governance by default approach, however, exposes the relative talents and shortcomings of courts in carrying out such a function. Further research is needed to examine how courts can be better supported to carry out these demands in effective and efficient ways. Given the politicization of scientific research in the electoral process and its effects on the legislative and executive branches of state and federal governments, the somewhat more insulated nature of the judicial selection process (largely through appointments, recommendations through state bar commissions, and/or

nonpartisan elections) may allow the courts to approach the nexus of science and public policy from a different perspective. A comparative analysis of the actions of such courts under varying pressures would prove instructive in appreciating the limits of courts as boundary organizations. Also, scrutiny of the role of courts in curtailing subsequent litigation, achieving lower rates of reversal on appeal, developing panels of outside scientific experts, and similar judicial approaches in response to wicked problems in water and land management deserve additional investigation.