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Collaborative networks and new ways of knowing

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ABSTRACT

To move beyond legal and regulatory gridlock around water issues in the California Bay-Delta, a new inter-agency initiative, commonly known as CALFED, was created in 1994. CALFED has been an ongoing experiment in policy innovation. Part of the change in management practice has involved constructing new arenas that engage multiple perspectives and transform regulatory impasse into provisional steps forward. We examine the construction of so-called boundary objects, which are forums and policy instruments that cross group boundaries and foster integrative deliberation. We compare the design and action of two boundary objects created by CALFED, namely the Environmental Water Account (EWA) and the Water Use Efficiency (WUE) program. We find that the presence of the boundary object, in itself, does little to explain the success of each policy experiment. Rather, the answer lies in the types of network interactions that result, along with the way meaning is coproduced. In fact, rather than create new patterns of interrelationship (e.g., between fish habitat advocates and pump station operators), the boundary object might further embed institutionalized routines. To more deeply understand what makes the new institution an integrative one, we introduce the concept of Ways of Knowing which explains how new knowledge emerges from the network of new relationships.

1. Introduction

Water management in California Bay-Delta presents an archetypal case of resource dilemma in that it is characterized by interconnectedness, complexity, uncertainty, conflict, multiplicity of perspective, and the ever-present threat of deadlock. On the one hand, reliable supplies of clean, affordable water for traditional claimants like cities, industries, and agriculture are dwindling. On the other, water managers are beset by rising claims for fish and wildlife habitat and other environmental purposes. And looming over all of these factors is the specter of climate change, dangling a giant question mark over water policy like a Damocles' sword. Structural solutions to augment water supplies through trans-basin diversions are financially and politically very difficult. Increasing storage capacity is no longer California's panacea for water, and we cannot assume that the solution lies in the elusive promise of desalination, which, given the direction of energy prices, seems increasingly infeasible. By now, most everyone in water policy recognizes that solutions will come from mixed strategies combining hard supply-side and soft demand-side approaches and from innovations in water management including not just new institutional forms but also new ways of knowing that forge coherence among multiple claimants.

Underscoring this discussion is the crucial nature of the Bay-Delta system (short for the San Francisco Bay/Sacramento-San Joaquin Delta estuary), which is the largest estuary

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on the United States' West Coast and also California's major water supply, providing two-thirds of California's drinking water and irrigation for 7 million acres of agricultural land. It is here where conflicting claims over the water take place in rather dramatic fashion.

2. Background

For water interests around the California Bay-Delta, 1982 dealt a major setback. Voters decisively defeated the peripheral canal, designed to move water around rather than directly through the Bay-Delta. Residents in Northern California opposed the loss of what they considered their water to the South. Environmentalists questioned the small number of environmentally friendly add-ons to the legislation. Agricultural interests in the San Joaquin Valley believed the deal included too many environmental restrictions. Through a process of ''benefit-spreading'', the policy package was designed to add numerous beneficiaries (who in the end did not support the legislation) and became so expensive that voters suffered from sticker shock (Nawi and Brandt, 2002).

Not only did water development come to a standstill, long dominant interests lost some of their previous gains through unfavorable court decisions and other events. First the courts in 1986, and then the Environmental Protection Agency (EPA) in 1990, disapproved of the state's water quality standards in the Delta as not meeting the requirements of the Clean Water Act. As a result, water entitlements of Central Valley farmers were cut. Even more ominous to dominant interests, the Sacramento River Winter-Run Salmon and the Delta Smelt were listed as endangered species. Because pumps serving the State Water Project and the Central Valley Project suck in fish despite precautionary measures, and fisheries agencies are empowered by the Endangered Species Act (ESA) to shut down the pumps if the ''take'' of endangered fish becomes too large, the reliability of water supply to cities and agricultural contractors was threatened.

Matters reached a head in what was widely referred to as the ''smeltdown.'' In June 1999, a story in the Sacramento Bee under the headline ''Protection of Fish Puts Farm [and] Bay Area Water at Risk'' quoted a high ranking local water official as saying ''what has emerged in the last 48–72 h is a real water supply crisis''. Numbers of endangered smelt had lingered around the pumping plants for weeks beyond normal, forcing operators to pump less than half what was normal.

The issues raised were more fundamental than aberrant fish behavior. Environmental and Wildlife agencies have missions that fundamentally conflict with the water community, making it impossible to accommodate everyone using the traditional pluralist politics of mutual accommodation and benefit-spreading strategies, as we will describe below (Lach et al., 2006). Further, the geopolitical underpinnings of water were drawn into question. Urban water utilities claimed that water for people trumped fish and crops and that there were growing cities south of the Delta than needed more water.

Why is innovation so imperative? Simply, because the simple allocative model that has ruled water supply management in California for a century is failing. The ''smeltdown'' debacle, where one water use (habitat maintenance) completely shut down another use (water supply) was a great reminder of this. The allocative model consists of divvying up a finite pie, consisting of so many acre-feet of reliable water that agencies expect to be available each year, across the constellation of users, each demanding so many acre-feet of water. Mathematically, the total acre-feet of water demanded has begun to exceed the acre-feet of water available, as has been experienced during dry years but, more recently, even in normal years. But this zero-sum formulation is being questioned. Increasingly, stakeholders are beginning to talk about overlapping uses, where the same acre-foot of water might actually be used to meet multiple demands simultaneously—this is reflected in industry terms like ''conjunctive use'' and ''integrated water management.'' The complexities of supply and demand need to be better understood and addressed. Given the current inability to expand storage, water supply has a diurnal, seasonal, and climatological ebb and flow that is ill expressed in gross terms like acre-footage. Demand has its own ebb and flow, also. The question, now, is whether a fine-tuned regime of supply and demand management might meet increasingly conflicting needs.

Innovation should emerge from the recognition that the system, both supply and demand, is more complex than the current water management regime can accommodate. As Innes and Booher suggest, there is a need for new institutional designs, most likely affording new venues for participatory system management, that can respond to complexity (Innes and Booher, 2005). They and others point to the idea of adaptive management as such a response, where learning occurs in real time from the interaction of multiple knowledge bases, scientific and non-technical.

CALFED is the inter-agency initiative that grew from the resolve to get past regulatory gridlock, and the California Bay-Delta Agency (CBDA) was the new organization charged with implementing it. Established as a consortium of 8 State and 10 Federal agencies in 1994, CALFED drew up a long-term plan of action formalized in a Record of Decision (ROD) in 2000, the idea being that solutions would likely come only when piecemeal, unilateral actions were replaced by concerted, comprehensive planning and action.

3. Conceptual and methodological approach

We begin by recognizing the multiple ways that water management is understood.

First of all, experts and citizens alike are beginning to confront water as a social–ecological system. In the Bay-Delta region, advances in the ecological sciences offer a deeper understanding of the meaning of water and suggest some important insights into how ecosystems might be better managed (Blatter et al., 2001). From this perspective, water is viewed as inseparable from other environmental elements that make up a particular watershed or bioregion. The characteristics of water, including quantities, chemical composition, temperature, and turbidity are suited to the habitats in which it is found. Small variations in stream temperatures caused by impoundments and return flows from irrigation can make a stream an unsuitable fish habitat. According to the lessons taught by taking this perspective in contemporary

water management, most water projects need to be re-engineered to more closely reflect natural systems.

Other perspectives, particularly the economic, suggest other policy positions. Water problems would evaporate if it were simply allowed to flow to its highest valued use—e.g., since water is worth a great deal more in urban households and industry than in farming, transferring water from farms to cities could solve California's water problems. From this point of view, many projects are simply an unwarranted subsidy to agriculture or fish protection.

Yet other water researchers are exploring new ways to improve water use efficiency (WUE) through technical means. Water reclamation, recycling and redistribution for outdoor watering, or groundwater recharge represent a potentially large source of recovered supply. Urban water conservation involves changing the portrayal of the good life in the golden state in ways that challenge suburbanites modes of land use (e.g., lush greeneries and lawns). There are movements in sustainable agriculture that may resurrect low-water, low-additive modes of cropping. And there has been a large transfer of water through leases and sales from agricultural areas to cities. Within this framework, water management is a problem of design.

Part of the change in management practice involves constructing arenas that engage multiple perspectives and creating forums that provide bridges between contending communities and policy actors. In a study of ground water management in the high plains, David Cash found that a common arena for collaboration facilitated adaptive management as it linked managers at different governmental levels, and sustained relationships over time as hydrological models were repeatedly advanced to incorporate emerging understandings (Cash, 2001). This management strategy also recognizes that local habitats and watersheds can be enormously complex, and that local residents often have invaluable knowledge and perspective. Adaptive management envisions incorporating locally based understandings along with more conventional science.

The new institutional design calls for a different kind of leadership, which some scholars have called inclusive management practice (Feldman and Khadamian, 2001). Inclusive management is defined as that which seeks to incorporate the knowledge, skills, resources, and perspectives of several actors. Inclusive management embraces the notion of process accountability, which comes not from external oversight so much as infused through processes of deliberation and transparency. As former Assistant Secretary for Water and Science in the Babbitt Administration, Elizabeth Anne Rieke writes, the CALFED process was "designed to create an overlay of procedures and processes to compensate for the perceived inadequacies of the statutory mechanisms for agency cooperation, federal-state collaboration, and stakeholder participation in decision-making (Rieke, 1996).

The research revolves around a comparison of two case studies, the WUE program and the Environmental Water Account (EWA), both created soon after the Federal ROD that was issued in 2000. Both programs were created by the CBDA to foster new innovative solutions to water conflict—in the case of the WUE, water conservation projects not currently being attempted, and in the EWA, fine-tuning the system of allocating water to its best and highest use. WUE is a grant program which solicits proposals from water agencies for water conservation projects, from which the most promising are chosen for subsidy. EWA is a market-based instrument that allows trading of water rights between different user types—e.g., agricultural users and fish protection advocates. The performance of both the WUE and EWA can be monitored according the volumes of water subject to the program—i.e., the acre-feet of water conserved as a result of the WUE subsidy, and the acre-feet of water traded under the EWA (*note*: the EWA also uses acre-feet of uncompensated water supply diversions as an indicator of program deficiency).

We will use several conceptual lenses to evaluate and contrast the WUE and EWA. The need to negotiate agreements with a diverse set of stakeholders suggests that we pay close attention to so-called "boundary work". According to Cash et al. (2003), boundary management requires three types of activities: communication, translation, and mediation across boundaries between differing organizations and stakeholder types. These functions can be carried out through boundary objects, which as defined by Starr and Griesemer (1989), are formal devices (e.g., reports, projects and artifacts) that are used by and adapted to by different groups and yet robust enough to maintain a lasting identity across these groups. In some cases, boundary work is institutionalized into a formal boundary organization. Cash et al. found that boundary organizations involve at least three key features: (i) the creation of special roles within the organization for boundary management, (ii) formally allocating roles among participants across the boundary, and (iii) providing a forum in which information can be coproduced by diverse actors using boundary objects.

We will examine both the WUE and EWA programs from the perspective of boundary management. As a preview of the analysis, we claim that the above boundary concepts seem insufficient to explain differences in the ability of these programs to achieve objectives and generate innovative solutions. To some extent, the notions of the boundary object and boundary organization fix our focus on structural features of the program. The focus on boundary management can hinder us from a more ecological understanding of a program—what Latour describes as the flow of objects and concepts through a network of policy actors (Latour, 1987). What is missing is a conceptual device more oriented toward process and the coproduction of meaning. For this, we introduce an alternative concept, the Way of Knowing (WoK) approach.

A WoK was described by Ingram and Schneider as "how one interprets the elements in a policy space and makes sense of the relationships among them. It is a narrative or story that holds all of the pieces together in a relatively coherent way..." (Ingram and Schneider, 2007). The WoK approach examines how new narratives or constructions are arrived at through the interaction of differing WoKs. Later in this article, we will talk about the different WoKs employed by the fish agencies as opposed to the water system operators. As opposed to the notion of frames, a concept introduced by Goffman (1974), which are maintained all throughout a policy process, WoKs are dynamic. WoKs constantly are in flux from the sheer interaction of objects (artifacts, reports, forums, etc.) in a policy space. The mere fact that there are two or more WoKs encountering each other ensures that none of the WoKs will

stay static. Similarities may reinforce stronger interpretations, and divergences may cause a regression to the mean (or its opposite effect). This is because, being an ecological concept, a WoK emerges from the entire suite of objects interacting in policy space—e.g., a person's understanding of a phenomenon like climate change emerges from many influences (e.g., scientific reports, personal experience, peer pressure, etc.). Moreover, policy emerges from the blend or interaction of different WoKs. We conceive of the WoK approach as a process theory, since it focuses our attention on the active process of meaning construction. As opposed to the notion of boundary maintenance, interaction of differing WoKs may produce a blurring of boundaries. The boundary approach suggests a situation where different policy actors communicate from within their respective WoKs, which maintain themselves throughout the policy process. The WoK approach assumes the transformation of these WoKs and, in fact, a possible merging of elements of these WoKs. This approach emphasizes processes of meaning generation rather than boundary maintenance.

How are different WoKs reconciled or integrated? One can try to identify a more general, inclusive framework, and call this a meta-narrative (Schön and Rein, 1995). But meta-narratives, or master frames, are too often simply higher-level abstractions. We would rather think of the relationship between WoKs in a Saussurean fashion. Ways of knowing, as understood herein, shift with the entry of each new object into the policy space, through the sheer interaction of the new element with the old ones. Some of these interactions may lie entirely outside the control of any policy actor. There is something Saussurean here where, within a system of differences with no positive elements, the meaning of an element (a word like ''dusk'') is established only in relation to its position vis-a-vis all the other words (like ''twilight''). In Saussure's structural theory of linguistics, language results from linking a signifier (i.e., a word or sound-image) with a signified (i.e., the concept). The specific meaning (or, in his words, ''value'') that results from linking signifier and signified means nothing on its own, but only in relation to all the other signs in the language-system. Dusk means dusk only in a relative position to other related words like twilight, night, sunset, and others—on its own, the word ''dusk'' means nothing. To quote: ''What I have said by focusing on the term value can be alternatively expressed by laying down the following principle: in the language (that is, a language state) there are only differences. Difference implies to our mind two positive terms between which the difference is established. But the paradox is that: In the language, there are only differences, without positive terms'' (de Saussure, 1959).

The notion of a ''Saussurean'' dialectic (which we introduce in this article) is to require that the two juxtaposed objects (e.g., the ''fish'' community's versus the ''ops'' community's WOKs) develop a relationship with each other. The relationship, moreover, can be conceptualized as having three dimensions: each side's own identity, each side's identity vis-à-vis the other's, as well as their joint identity (Lejano, 2006). Each perspective or WoK develops added meaning when paired with a different perspective, and new meaning is created when we have them together. In the end, even each individual way of thinking changes. This deepens our understanding of inclusive processes, which so often assumes that magic happens when each stakeholder brings hidden ''pearls of wisdom'' to the table. Rather, we see the creation of new or higher-level WoK to happen not within the stores of knowledge possessed by any camp, but in the exchange (i.e., the relationship, the conversation and the translation) that occurs between them. The magic occurs through the creation of a new (social, discursive and formal) relationship between different WoKs.

The case study research involved review of archival material (subcommittee reports, meeting minutes), interviews with key personnel, and participant–observer research. The latter was facilitated by the membership of one of the co-authors in both the WUE and EWA subcommittees. Interviews were conducted by the same author and a graduate research assistant. Subcommittee work was a significant source of analytical insights—these subcommittee meetings would usually involve presentations by staff members and other representatives followed by extensive question-and-answer session. Analysis involved assessing how both process and outcome changed over time, in the case of both the WUE and EWA. We essentially judge the programs by a number of ''measures''—i.e., the extent to which its design corresponds to what authors attribute to boundary organizations and good boundary management, the extent to which performance goals were met, the degree of evolution of program design and process, and the production of innovative solutions.

Data for this study was collected through participant observation. The structural design of CALFED included an independent chief scientist and a number of scientific advisory committees that grew over time until CALFED was reorganized in 2006. In the initial ROD related to the EWA that was portrayed as experimental, a scientific review committee was charged with the task of conducting an inquiry and issuing an annual report (California Bay-Delta Authority, 2005). This committee existed from 2001 until 2004. While much of the attention of the committee was directed toward fish science, management and decision-making were also deemed important, and along with physical scientists and engineers, the committee included two legal scholars and a political scientist, one of the authors of this article. Similarly, but later in 2004, a water management science board was created with a WUE subcommittee, neither of which had a public reporting charge. The co-author was a member of both these groups until 2006. Membership in these scientific bodies afforded access to many days of testimony from program participants, including the opportunity to ask questions. Further, since the boards were official ongoing activities, it was possible to observe how organizations and relationships developed over time. Contacts made during meetings with administrative officials and interested stakeholder representatives during meetings allowed for both extended ''coffee break'' conversations and follow up phone calls.

4. Analysis

4.1. *The urban Water Use Efficiency program*

The ROD established the goal of the WUE program, which was to accelerate implementation of cost-effective water conser-

vation actions contributing to California Bay-Delta water supply reliability, water quality, and ecosystem restoration goals. The rationale for promoting WUE was that results would be faster than infrastructure construction and generate significant benefits in water quality and timing of in stream flows, even where they may not generate a net increase in available consumptively used water.

The ROD directed agencies to implement 14 best management practices (BMPs) for urban water conservation. The BMPS originated in 1998 from the California Urban Water Conservation Council (CUWCC), a powerfully organized association of urban water agencies who actively participated in the CALFED negotiations. Although the ROD states that urban conservation incentives were designed to identify and implement measures that are supplemental to BMPs and cost effective from a statewide perspective (CALFED, 2000), the effect of the BMPs placed in the ROD has been to build the urban WUE around a central pillar of BMPs that are cost effective for local agencies. Given the emphasis on BMPs, it is worth noting that only 4 of the 14 BMPs (29%) are actions that directly reduce water consumption. Other BMPs address education and administrative improvements.

Although the design of the incentives matches the intent of the ROD to require partnerships with local interests, this was only partially met. Notably absent from the dialogue were differing voices originating from outside the domain of local water and state water agencies, except possibly through the Public Advisory Board and its WUE Subcommittee.

By adopting the BMPs of the CUWCC water agencies, CALFED deferred to the water agencies as the technical experts in urban conservation. Furthermore, the ROD, and by extension the WUE program, cemented the definition of what constitutes a BMP, discouraging innovation. The BMPs exhibited a water utility-centric perspective on water conservation and represented a static organizational power structure. Designed to operate within the existing hierarchy of urban water agencies, the BMPs do not allow other policy actors to enter the arena. The BMPs set the agenda, limiting how issues would be defined, who in effect were eligible for grants, and ultimately how much water is conserved.

A series of grants were the primary tool used by CALFED to effect conservation. The grant Request for Proposals (RFP) in 2001, the first year, was developed by the WUE Grant Team composed of the Department of Water Resources, the U.S. Bureau of Reclamation, the Natural Resources Conservation Service, and CBDA, representing government interests at the state and federal levels for urban water supply, agricultural supply, and urban and agricultural conservation. The RFP was open to the widest possible range of applicants for projects using either BMPs or other approaches. About 70% of the proposals were submitted by water supply districts, departments, and companies who subsequently received about 70% of the awards totaling about $4.4 million compared to $6 million for other types of applicants including $4.4 million to the Electric and Gas Industry Association for high efficiency washers. NGOs also applied for, and some received, grants. One NGO consortium hired scientists to develop a plan for water conservation and recycling and coastline wetlands preservations in San Francisco. (San Francisco does not have a water recycling program.) This example illustrates the legitimating effect on less-recognized parties by a grant program with broad eligibility. Throughout the RFP process, the agencies provided a high level of transparency through public announcements, meetings, and detailed postings on the web.

The program shifted in 2002 to a contracted list of eligible applicants exclusively comprising local water agencies with projects meeting specific BMPs most likely to reduce water use through technology changes. State propositions funded the majority of urban WUE grants through Proposition 13 Urban Water Conservation Capital Outlay grant program. Other grants were funded through other state funds, resulting in both grant programs administered by DWR with review support from the Grant Team and a science and economics technical teams. Nearly $8.9 million went to 21 projects. The approved projects were predictable and lacking the innovation seen in the previous year's proposals. In both years, the RFPs did not require projections or later verification of water savings. By 2003, the challenge of acquiring data to evaluate water savings was apparent.

The following grant cycle was postponed to 2004 while CBDA worked to integrate the conservation program with the Science Program and other CALFED programs. Managers met jointly and identified needs for performance measures to evaluate WUE-funded projects, applied research needs driven by the adaptive management process, and to project future costs and benefits from WUE projects. The 2004 RFP contained important changes. Two criteria were added for (1) monitoring and assessment to fill the scientific gaps in the grant program and (2) innovation, inviting proposers to present novel solutions less constrained by the list of BMPs. The RFP required applicants to estimate water savings. Grant eligibility expanded broadly, but applicants would have to demonstrate matching funds.

Reviewers expanded to include 50 individuals from CALFED agencies – including an economist, a tribal coordinator, and a scientist – as well as environmental, urban, and agricultural stakeholder groups actively involved in WUE programs. The WUE Agency Team managers from CALFED agencies recommended contractual terms to ensure that a project's Bay-Delta benefits would be quantified and assured (Department of Water Resources, 2005). Eligible projects expanded to include research needs, mostly for scientific quantification (e.g., data loggers). CALFED also invited a survey of water customer motivations to save water. This single item offered more citizen involvement by capturing people's water values and needs, although it appears that, if proposed, such a survey was not funded. Of 45 urban projects selected in June 2005, 26 were awarded to water agencies and 19 to industry associations (notably several awards to CUWCC), universities, and one NGO. Changes in eligible participants and projects and changes to proposal reviewers suggest the effects of the feedback mechanism of adaptive management.

Despite these seemingly positive changes, numerous rules for grant applications limit applicants every year; only professionals and applied scientists would ever be able to prepare a successful proposal. Other types of public agencies are explicitly excluded, such as zoning, land use, environmental health, and building permitting agencies. These agencies could possibly provide substantial contributions to

water conservation, for instance, by requiring in-building water recycling in commercial buildings or incentives for residential greywater recycling.

The WUE corresponds to the classic definition of a boundary organization. It acted as a mediator that coordinated water conservation activities across a large set of water agencies (as reflected in the organizational chart, shown in Fig. 1). It communicated a common set of standards, program objectives, and plans across boundaries. It also translated technical material into readily understood directions through its WUE Proposal Package Guidance Report.

The WUE had the essential elements that Cash et al. (2003) point to as constituting effective boundary organizations. It formally created special functions within the WUE organizations just for boundary work—e.g., data clearinghouse, scientific advisory committee, and project liasons. It allocated tasks among participants—e.g., proposal preparation, technical review and monitoring. And it created a forum for communication and cooperation. And yet, by its third year of implementation, the WUE was found wanting in the way of output—''Implementation was problematic and the resulting performance was unsatisfactory (WUE Subcommittee, 2005)''. Why was this? First, the WUE originally assumed a suite of feasible activities that later on turned out less than feasible—with the result that water agencies found less than expected volumes of water conservation activity to be sensible for them.

A second reason lies behind this, and it is, in our opinion, because the WUE did not result in new BMPs that were beyond those originally conceived in the planning stage. Thus, a real problem for the WUE was its inability to spur extensive innovation. Essentially, the water conservation projects that the WUE delivered, since its inception in 2000, represents the limit of what is feasible within the scope of the BMPs identified in the program plan. What was missing, and the shortfall between what was achieved and what was desired, was the generation of innovative practices that might have resulted in additional water savings. For example, in one of the program evaluation exercises, a technical review committee concluded that not much information was generated regarding new ways of demand management (WUE Subcommittee, 2005). Compounding all this was the problem that WUE consistently generated less than the anticipated funding.

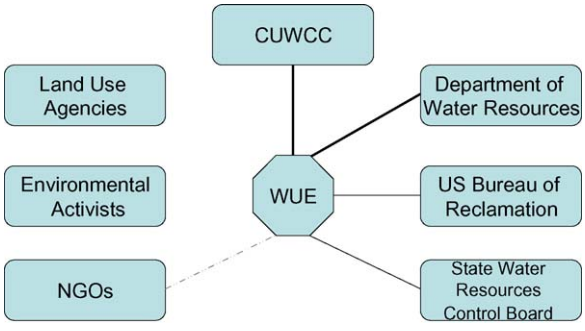

Fig. 1 – As a boundary organization for urban water conservation, CBDA links to CUWCC water agencies and implementing agencies while other possible actors essentially remain outside the arena.

In terms of both process and outcome, WUE's progress over time seemed inadequate. Over its first 7 years, 125,000 acre-feet of urban and agricultural water conservation was funded by WUE, well short of the projected 780,000–1,038,000 acre-feet (Bay-Delta Public Advisory Commission, 2007). Process-wise, the basic format was maintained, consisting of submittals by water contractors, evaluation by the WUE committee, and awarding of grants. The majority of water suppliers that committed to a schedule of 14 BMPs were out of compliance with the implementation schedule, and for nine of the BMPs the rate of compliance was less than 50% (Mitchell and Gohring, 2005).

What was behind the lack of innovation? The first factor was the regulatory design of the institution, where the WUE functioned as a centralized coordinating body. In this function, the WUE imposed its set of pre-defined BMPs onto the field, resulting in a dampening of the innovative dimension. While CUWCC is not an ''implementing agency,'' the central role of the BMPs cause the association to act as an implementing party, upon which CBDA and the CALFED Program are beholden to achieve their goals. Regardless of the State's need to reduce water withdrawals from the Bay-Delta, member agencies agree to implement only those BMPs that are cost effective for the agency. From the perspective of a local water agency, noncompliance merely reduces conservation grant funding opportunities without affecting eligibility for other CALFED or State funding. Thus the upper limit of conservation through BMP implementation is set by what is calculated as cost effective at the local level and cannot reasonably be expected to reflect the State's concern for fish declines from water withdrawals or other CALFED concerns.

This blueprinting of practice through instruments like BMPs hinders the employment of local initiative and knowledge in solution generation, as has been argued elsewhere (Lejano, 2006; Berkes, 2007; Lejano and Ingram, 2007). But what allows this is, ironically, the structure of the boundary organization, where one body serves as a centralized hub for, as Cash et al. describe, communication, translation, and mediation. From where might have innovation evolved? One source would have been close relationships between the multiple stakeholders, exchanging information and sharing practices. It might have emerged from the interaction between the scientific, technical expertise of the regulatory agencies with the different bases of experience encountered by water agencies in practice. It might have come from new ideas about optimizing water system operation or demand management. But this required a different structural design than the classic one of the boundary organization. It also requires that we pay attention to elements of practice that are not design-related, such as how new ideas and narratives are constructed. In other words, we need to turn from a focus on ''boundary management'' to that of ''meaning management.'' In the following section, we will see how this worked in the case of the EWA.

4.2. *Environmental Water Account*

The EWA is an innovative program wherein fisheries agencies own and manage an allocation of water. EWA reflects a

backing away from the regulatory approach that had marked fish protection. Instead of simply mandating water releases and letting water contractors whose expectations of water supplies were disappointed bear the cost, fisheries agencies themselves were to own and manage the water. EWA involves voluntary water sales and contracts. It guarantees that environmental water will be available for fish with costs compensated to the contracting agencies (cities and farms). It also modifies the role of fish agencies that were to manage the account, and requires a close working relationship with facilities operators not previously sympathetic to fisheries problems.

An integral aspect of EWA's innovative design is its dependence on water acquisition through voluntary markets rather than governmental mandate. There are concerns about the ancillary effects of water sales on agricultural communities and the accommodation of urban growth and development that many environmentalists oppose. Consequently, many water sales are quite controversial, though they have been taking place with regularity for over 30 years. The sale of 200,000 acre-feet of water from the Imperial Valley to the City of San Diego took nearly a decade and enormous political capital to accomplish. That transfer continues to have bitter enemies among some farmers in the Republic of Mexico who will inevitably suffer negative indirect effects. In contrast, the EWA, which in some years has moved almost as many acre-feet, was negotiated in months and has a generally favorable public image.

The idea of protecting the environment through markets is an old idea favored by many water resource economists. To others, however, the idea seemed wrongheaded. According to the public trust doctrine, the state was supposed to guarantee the use of water in the public interest of citizens, and if low flows were endangering fish, then diversions from the streams should be regulated. The citizens should not have to pay to purchase the welfare (e.g., adequate flows for fish) already guaranteed. Agricultural interests feared that if problems were solved through markets, there would be less public support for the infrastructure projects they believed essential. Although water sales might make individual farmers better off, the farming communities would suffer as people moved off the land and no longer supported local businesses, schools, and civic enterprises. Further, water sales to city or state governments raises demand and water prices, making water more expensive in local water markets among farmers. As a consequence, water markets were more talked about than actively pursued, until recently.

Most important for this paper, the inclusive process has worked across perceptual, knowledge-based, and organizational boundaries. In the vernacular of California water resources, the world can sometimes seem divided between the ''MAs'' and the ''PAs''. The MAs stand for the management agencies responsible for fish management and includes the state and federal fisheries agencies in the California Department of Natural Resources, the U.S. Department of the Interior, and the National Marine Fisheries Service within National Oceanographic and Atmospheric Administration. The PAs are the project agencies that include the managers of federal and state water project operations located in the California State Department of Water Resources and the U.S. Bureau of Reclamation. MAs and PAs represent distinctly different ways of knowing.

MAs look at water resources from the fish's point of view. Fisheries managers see rivers, riverbanks, and riverbeds as habitat, and their central concern is preserving river systems in which native fish can thrive. There are hundreds of threats to fish survival, only some of which relate to water supply, and then often only indirectly as streamflow affects dissolved oxygen, temperature, turbidity, supply of nutrients and so forth. The life cycle of fishes is not well understood, and the relative risks of different stressors are not known, particularly for less studied species like Delta Smelt. Fish biologists know that some fish, particularly salmon, have finely tuned genetic variations to take advantage of natural flux in water flows. Salmon spread their risk for survival by separating themselves into distinctive ''runs'' or races that migrate at different times of the year, spend more or less time in the estuary and ocean, and return to particular streams from which they once migrated as fry to spawn. As a consequence, salmon have been able to survive floods, droughts, warmer waters or dangerous ocean conditions. What is damaging to one salmon run may not hurt another. Since differentiation has worked well to insure salmon survival, fish biologists are quite concerned about loss of diversity from human interventions. Losing a fish ''run'' means that the species has a narrowed range of tolerance and less chance of ultimate survival.

From the perspective of the biologists that manage fish, human interventions in river systems are damaging. Fish managers sometimes weigh alternatives in comparison to some idealized natural river that would exist were it not for human manipulation. Without dams and diversions, spring floods would occur and water temperatures would remain low. Large changes in the ''natural'' river are usually viewed negatively by MAs. For instance, the gigantic pumps that suck water from the California Bay-Delta, sending it to farms in the Central Valley and urban areas in Southern California, are identified as a major impediment to fish survival. While it is difficult to quantify how many fish are saved when the pumps are turned off and whether that number is sufficient to assure survival, from the perspective of the MAs the fewer days the pumps are operating the better, especially during the migration periods. This is complicated by the different needs of different species. Delta smelt, for instance, shows up at the pumps at a different time of year than when the salmon migrate.

In contrast, PAs see water as a commodity, the product of an engineering process that tames the vagaries of nature and allows engineers to produce water products at different times to different places in different quantities, qualities, temperatures and so forth. Fish are but one of a large number of claimants on water resources, and in terms of economic value, far less important than municipal, industrial or even agricultural users. Infrastructure like dams, diversions, pumps and levees allow PAs to actively manage water to serve society's goals. To a water engineer, a river system must be altered to serve the multiple uses to which water is put, and flows must be evened out so that spring floods are stored for summer uses. Engineering works divert water from one river to another to meet demand.

A special class of water engineer, the project operator, is in charge of running the infrastructure. The overriding value of the project operator is to assure reliability. Such management involves releasing water from dams, turning pumps on and off and determining flow velocities. Since users have very different requirements, and river systems are by nature constantly changing, project operators have developed very sophisticated protocols to send water where and when it is needed while avoiding floods and maintaining necessary water quality. Professional norms, laws and regulations govern some of this protocol. Other parts of the rules are more discretionary. Operators speak of experiential knowledge and knowing their own engineered river system and its unique quirks. While water engineers are not given to expressing ideals, their preferred state could be said to be a completely controlled river system. A ''natural river'' as biologists think of it is a complete anathema.

While MAs and PAs have dealt with each other for decades, they seldom see water problems in the same light. Fundamentally, nature is viewed quite differently. Fish managers appreciate nature undiminished by human interference, and project managers value nature as controlled by human ingenuity. MAs concentrate on gains and losses among threatened and endangered populations and subpopulations over seasons, years, and decades. PAs are concerned with hour to hour and sometimes minute to minute issues of water supply and making certain that when anyone turns on the tap anywhere, water will come out. MAs are concerned about preserving species and natural diversity, and believe that the loss of genetic material through species extinction is incalculable. PAs weigh the value of water in economic terms; agencies are paid for water delivered to homes, industries and farms, or run through electrical generating facilities.

One of the requirements of the ESA is that a recovery plan must be prepared for any species listed as endangered, specifying when water in dams must be used for fish and when other operations, like turbines or pumps, must be shut down. The ''smeltdown'' of 1999 was an important impetus for the adoption of the new legislations mandating ''adaptive management'' in the California Bay-Delta. During its 3 years of existence, CBDA funded fish studies at a very high level. New knowledge about ecosystems management revealed that to save fish, many environmental parameters must be varied in a flexible fashion to respond to species needs in real time. Often ESA regulations were too clumsy and inflexible to serve the fine-tuning those ecosystems required.

The EWA acted as a boundary object, enabling people to bridge the gap between different Ways of Knowing (see Fig. 2). Under the inclusive management process of the CALFED ROD, fish managers met weekly and sometimes daily with water project operators to determine when to store, move, and release environmental waters purchased through EWA. Through the regular meetings about the management of this mutually understood boundary object, fish managers came to have some sympathy for the constraints under which operators worked. Similarly, operators came to better understand the multiple aspects of water favorable to fish survival. New networks, new relationships, and new language related to the notion of adaptive management helped transcend boundaries. Over the first 5 years, real changes in the

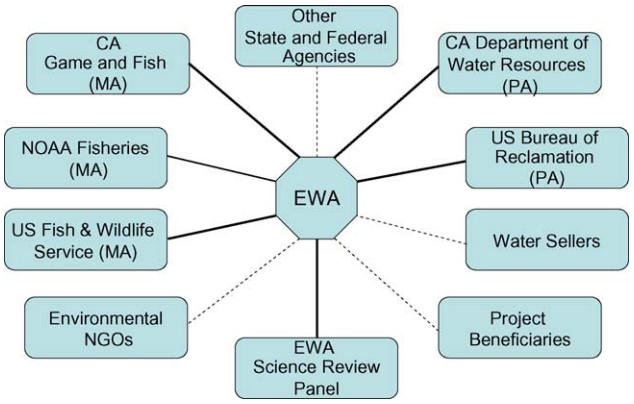

Fig. 2 – Links between the California Bay-Delta Authority and the implementing agencies and key stakeholders of the Environmental Water Account exhibit a rich potential for trans-agency solutions.

managers' attitudes and Science Review Panel produced new levels of trust. Moreover, over this same period, there were no uncompensated water supply reductions.

It is important to distinguish the EWA from traditional allocative solutions. In this case, fish managers were given water like every other user, but the task of managing that water in concert with others altered their perspectives. MAs are supposed to decide whether or not to spend its water assets on the basis of real time information about fish movements. This was a marked departure from previous practice where pumping levels were set automatically at a low level during certain months even though fish might not be present during those months and no protection in other months other than triggering the draconian ESA that curtails pumping operations. When endangered fish show up at the pumps at abnormal times, the release of environmental water is supposed to avoid an excessive take of endangered fish such as had occurred during the ''smelt down.'' Fish managers now must be water brokers, deciding in real-time whether to expend assets to address present fisheries management problems with a particular species or to save water for future problems that may arise with other endangered fish. According to one participant, a paradigm shift has occurred among fish agency managers who are now interested in how much water costs (telephone interview with David Fullerton, 19 November 2003). Fish managers manage not just fish, but also water assets, and must consider risks to both simultaneously.

In statements to the Scientific Advisory Committee and conversations with one of the co-authors, both fish managers and project operators stated that continuous interaction required for the joint operation of the EWA built trust and confidence between the two communities. In its report, the Scientific Advisory Committee noted that significant increases had occurred over the period of 4 years in communication and cooperation. More interesting from the perspective of this article, however, were changes in ways of knowing. Initially it was hoped that fish managers, put under the constraints of a water budget that limited in absolute terms the amounts of water they had to release, would budget their releases much as irrigators do. This did occur, and fish managers repeatedly

acknowledged that they were preoccupied with stretching their EWA supplies to last through the different critical seasons for endangered smelt and salmon. Trust and communication with project managers were critical in budgeting EWA water supplies because operators could help managers distinguish between when they could rely upon normal spills that would have to take place irrespective of the EWA and when drawing upon the account was necessary. Through interaction with project operators, fish managers became better acquainted with the characteristics of the built hydrological system, including travel time of water from storage to critical habitat, the delicate balancing of demands operators must do to serve irrigators, cities, recreationists, and others as well as fish. While they remained fish-centric, managers gained a perspective on the entire system, built as well as natural, that supplies water to them.

Operators in charge of managing dams, diversions, releases, impoundment and the like also changed perspective. Operators have long known that watersheds and river basins are more than the sum of their parts, and that operations have a great deal of art and craft elements. However, craft skills had been honed to meet the demands of flood and drought control, municipal water utilities, hydroelectrical energy, and agriculture. The fish were regarded as both less important and less serious than other claimants. Close association with fish managers through the EWA changed their level of biological understanding and their respect for the intricacies of fish managers concerns. They came to know a new dimension of their watersheds and basins as habitat and grew more sensitive to issues of temperature and the critical need for additional water at certain moments in the life cycle of fish.

5. Assessment and conclusion

CALFED established a number of programs with the intention of creating new policy ideas and consensus. To achieve this, new policy instruments acting as boundary objects, namely the EWA and the WUE, were created. We need to reconcile the divergent outcomes of these two policy experiments.

First, we see the limitation of the boundary object as an explanatory tool. In and of themselves, boundary objects and organizations are simply structural notions. Merely imposing them across organizational boundaries generates no sustainable change. Rather, the object is a surrogate for processes that effect such change. A deeper understanding of the nature of the process, who becomes involved, how different the perspectives of participants are, and what sorts of modifications in different ways of knowing about the boundary object occurs.

It is not enough to insert the boundary object into the institutional mix. Rather, the new object needs to create linkages between groups and forge sustainable relationships across them—i.e., the creation of a new social or knowledge network. The EWA required ongoing and, in fact, weekly meetings among different policy actors. The ''ops'' person running the pumps continued this conversation outside the weekly meetings as well. Regular interactions over issues of when to release stored water and where led to changed attitudes and trust. Science, which had credibility because it came from an outside team of experts, not only helped actors to adjust, but conferred legitimacy to the effort. Most importantly, the EWA forced the ''fish'' people to think like ''ops'' people and the ''ops'' people to think like ''fish'' people. The emergence of a new WoK and social network results from this forging of relationships. It is not simply having the conversation across boundaries that did the trick, it was also the fact that the conversation had a purpose, which was negotiating amounts and prices for water under the EWA. It is ironic that the EWA, which is essentially a market-based instrument, acted to create sustainable solutions precisely by acting in a non-market-like way. The Saussurean dynamic of one WoK being forced to encounter another produced new knowledge. Departing from the linguistic analogy, we realize that institutions are not merely text wherein the language-system automatically relates one entity to another. Encounter has to be designed into the institution—elements that fostered it included linkages across groups, outside science, and routinized interactions.[1] Another feature was the network design of EWA, something that the organizational chart in Fig. 2 cannot show, engendering face-to-face interactions among different policy actors. The fact that differing sides had to reach agreement in order for water to be allocated required differing WoKs to contend with each other and allow new meanings to emerge.

In contrast, the WUE did not require the creation or refashioning of new relationships. Forged out of already existing BMP templates developed within the water districts, the grant program simply further entrenched the embedded institutions, practices, and knowledges in these BMP regimes. The WUE reflects a continuation of path dependency with only modest adjustments rather than a meaningful move toward transformation. In the ROD and framework document, water agency BMPs set the agenda and became dominant elements of the rules. The organization representing urban water supply agencies, CUWCC, actually wrote the BMPs and continued as a dominant player in WUE, crowding out CBDA's attempts to act as a boundary organization and open up the process to wider participation. The BMPs as fashioned protect the water agency hierarchy, set limitations on the definition of issues, and undercut the ultimate performance of the urban WUE Program. There was no mechanism to require the substantive inclusion of other WoKs into the process. There was no ongoing institutional mechanism that might allow the forging of relationships and encounter of different WoKs with each other. No new learning occurred.

In closing, we note that any communicative model, including our analysis of interacting WoKs, implies some sharing of power. Again, this needs to be designed into the institution. On the face of it, EWA was framed upon the WoK of water-as-commodity—in this sense, perhaps, we might see privileging of one side of the negotiation. At this level, the commodification of water might have acted as the BMPs did with the WUE, constraining the definition of issues. But within this overall framework, on a level closer to practice, the program was designed such that fish advocates were accorded water rights equal to that of water supply, allowing a

[1] We acknowledge one reviewer's helpful comments for this insight.

discussion to occur between these sides on equal footing. In this manner, the EWA acted, in its boundary management role, not as an intermediary but as a forum for direct linkages among policy actors. It was relational, in purpose and design.

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