

The Weakness of Tight Ties: Why Scientists Almost Destroyed the Coachella Valley Multispecies Habitat Conservation Plan in Order to Save it

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Abstract Two groups of biologists were responsible for an unprecedented delay in completing an endangered species habitat conservation plan in the Coachella Valley of southern California. While antagonism grew as each group relentlessly promoted their perspective on whether to add a few areas to the habitat preserve, their inability to resolve their differences was not simply a matter of mistrust or poor facilitation. I analyze how these biologists practiced science in a way that supported specific institutional and ecological relationships that in turn provided a setting in which each group's biological expertise was meaningful, credible, and useful. This tight coupling between scientific practice and society meant that something was more important to these scientists than finishing the plan. For both factions of biologists, ensuring the survival of native species in the valley rested on their ability to catalyze institutional relationships that were compatible with their scientific practice. Understanding this co-production of science and the social order is a first step toward effectively incorporating different experts in negotiation and implementation of technically complex collaborative agreements.

Keywords Collaboration · Scientific advisory committee · Co-production · Endangered species · Habitat conservation plan

Introduction

In late 2001, an endangered species conservation planning effort in the Coachella Valley of southern California (Fig. 1) almost collapsed after the scientific advisory committee (SAC) failed to reach consensus on the design of a preserve within a multispecies habitat conservation plan (MSHCP). Although scientific advisors were committed to ensuring species survival, they split into two deeply antagonistic factions, each insisting on the superiority of their own design and refusing to change their position over a year of increasingly tense meetings. This conflict frustrated and mystified the jurisdictions that were sponsoring this collaborative planning process, who had been waiting for years for the scientific advisors to hand them a multispecies habitat preserve that they could quickly approve.

This deadlock was all the more troubling to plan stakeholders because they had come to rely on a uniform and confident position from the scientific community over the past two decades of endangered species management in the Coachella Valley. The scientific deadlock of 2001 began to unravel this longstanding arrangement, so the organizers of the MSHCP dismissed the SAC and restarted the design process for the preserve, which took seven more years to complete. This outcome was recently described in this journal (Alagona and Pincetl 2007) in terms of the consequences of poor facilitation and inattention to engaging stakeholders in a collaborative process. Planning “train wrecks” like this have long provided dramatic evidence of the unpleasant consequences of coordinating multistakeholder agreements without skilled facilitation (Fisher 1983; Susskind 1987; Wondolleck 2000).

In this article, I draw on 4 years observing the inner workings of the SAC to reconsider why this plan was

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Fig. 1 Regional map showing Coachella Valley

contested and delayed. I begin by describing how the local biologists supported a longstanding accommodation between the Coachella Valley's endangered species and people, who in turn provided a setting in which local biological expertise was meaningful, credible, and useful. I then describe how the local biologists came to paralyzing deadlock with the regulatory biologists, whose expertise was grounded in a different institutional setting. Analyzing the unyielding positions adopted by both groups of SAC biologists, I describe the SAC's relationship trouble as an outcome rather than a cause of deadlock, I trace how their differences were grounded in tight coupling between expertise and institutions, and explain why each faction found the proposals of the other faction so threatening and difficult to comprehend. I conclude with recommendations on how to incorporate diverse experts when negotiating and implementing technically complex agreements.

Analyzing Co-Production

This study is grounded in a reciprocal and dialectical conception of the relationship between science and society called co-production (Jasanoff 2004). Rejecting both social construction and scientific objectivism, co-production follows the parallel and interactive development of science and society. Linking knowledge production and the social order suggests that scientific and technical work has a role in sustaining and re-making society, in addition to making new discoveries and increasing efficiency (Latour 1993). This is not an endorsement of technocracy nor politicized science, but a dialectic in which scientists "...create, select and maintain a polity within which they operate and make

their intellectual product" (Shapin and Schaffer 1985). This framework supports analysis of how science stabilizes a particular social order as well as how knowledge practice can promote social change.

Studying scientific co-production is challenging because it is at odds with the way that most experts understand, describe and document the way that knowledge is produced. Scientific rationality is a search for a single correct solution, distinguishing fact and value in the quest for reliable and objective truths. Ideas that have withstood peer review or controversy are qualities of nature, while rejected views are a product of scientific error or misconduct (Vaughan 1999). Within planning and policy research the universality of scientific practice has come under twin assault, from the theoretical side by the new historicism in the philosophy of science initiated by Thomas Kuhn (1970), and from the empirical side through analysis of science-intensive controversies where different experts rely on divergent knowledge practices to persuade, criticize, and defend. These developments are worth examining more closely here, both to acknowledge how they break with and maintain continuity with positivist analysis.

Kuhn's "Structure of Scientific Revolutions" traced how research methods, model experiments, and technical languages inhibit communication between scientific paradigms, since these distinctions were learned through practice rather than explicit formulation and constituted a kind of "craft knowledge." While providing a foundation for the idea of epistemic diversity, Kuhn also insulated scientific practice by linking epistemic distinctions to research practices, rather than a wider social world (Fuller 2000). This separation is nearly ubiquitous within post-positivist analysis in planning and policymaking. Ozawa's (1991) fine-grained case studies of science-intensive disputes suggest that scientific consensus is impossible across incommensurable disciplinary paradigms. More recently, Corburn (2003) wrote that while communities have locally situated knowledge practices, science is characterized by "universal principles and theories" that emerge "...from a profession or discipline that undergoes a series of professional legitimacy "tests" (i.e., case-controlled experiments, statistical analyses, peer review, etc.)." These works challenge positivist research while retaining the assumption that science and policymaking remain separate cultures (Caplan 1979), interacting in a kind of "trading zone" (Galison 1997) in which experts produce knowledge in exchange for monetary and institutional resources.

This loose coupling between science and policymaking retains their clear boundaries and identities and independent existence, rather than reshaping or mutual construction to create more than the sum of their parts (Hunt and Shackley 1999). These fundamental assumptions are pervasive within planning and policymaking, underlying the

two most predominant conceptual frameworks for analyzing science-policy relationship, the epistemic communities model and advocacy coalition framework. Advocacy coalitions are agency officials, legislators, advocacy group staff and others whose shared policy objectives are grounded in deep, stable ontological and normative beliefs, such as liberal or conservative conceptions of the relative value of individual freedom and social equality (Sabatier and Pelkey 1987). In contrast, an epistemic community is “a network of professionals with recognized expertise and competence in a particular policy domain and an authoritative claim to policy-relevant knowledge within that domain or issue-area” (Haas 1992). Its members coalesce around similar problem definitions, theoretical assumptions, methods, and criteria for validating knowledge in their area of know-how. Members of an epistemic community can be part of an advocacy coalition if they share in its core beliefs, although their knowledge plays a supporting rather a defining role, validating the coalition’s core beliefs and legitimizing coalition arguments against opponents, who in turn rely on other knowledge that validates different core beliefs (Dudley and Richardson 1996; Weible 2008). Coupled together, these two frameworks facilitate policing the border of science and politics. An epistemic community is defined by its knowledge practices and an advocacy coalition by its core beliefs, definitions that reinforce the separation of science and society rather than explore hybrid or mutually constructed relationships.

Co-production breaches this border, enabling examination of the mutual construction of scientific practice and society. Broad spectrum analysis of co-production has compared national regulatory cultures (Jasanoff 2004) and the co-evolution of expert knowledge and global governance (Miller 2004), changing conceptions of biological kinship (Haraway 1997), and even century-spanning epistemic shifts (Foucault 1970). In addition, higher resolution studies of the interlacing of expertise to institutional setting have followed the diversification of scientific practice since the 1960’s, as new groups developed technical expertise in order to engage in legal and political action to pursue equal treatment, environmental protection, and decent living standards (Clarke 1998) and experts have engaged in controversies through venues such as regulatory peer review and technical advisory committees (Jasanoff 1990; Hilgartner 2000). Co-production is a way to examine this diversification of science and politics, tracing how solid and useful facts about the world are interpenetrated with social commitments, a “reliable, partly shareable, tropelaced, worldly, accountable, non-innocent knowledge” (Haraway 1997). Rather than side with the experts in their efforts to differentiate their science from social contamination, these efforts are often analyzed as rhetorical

strategies to legitimize scientific involvement in politically sensitive activities (Gieryn 1983; Moore 1996).

Methods

Co-production is a process rather than an outcome, so to understand it you need to watch the process unfold. I attended and videotaped twenty SAC meetings during the time when the crippling controversy occurred, from June 1999 to October 2001. I also attended 6 stakeholder meetings and numerous field trips and strategy meetings held outside the SAC and conducted 16 contemporaneous semi-structured interviews with individual SAC biologists and 19 interviews with other plan participants. From the beginning of data collection, I prepared interview transcripts and summary logs and partial transcription of the videotapes, and entered these text files into NVIVO™ qualitative analysis software. I used a grounded theory approach (Strauss 1990) to analyze the data, beginning by coding sentences and phrases to chart specific instances of emergent concepts, and then conducting further interviews and observation to test and refine the codes. I drew out categories and subcategories of relationships among the data to develop an emergent framework that drew on and reinterpreted co-production theory. As this interpretive model took shape, I fed new data into the analysis to complete the “grounding” of the theory. To check and support my final analysis, I solicited feedback after presenting my findings to MSHCP participants and followed up with final interviews with all six SAC biologists.

The Lizard Club

Like the Galapagos Islands, the Coachella Valley of southern California has many unique species because it is largely separated from surrounding lands, although not by water but by mountains. These steep-sided treeless slopes reach over ten thousand feet and isolate the desert valley’s many unique insects, plants, and small mammals (Fig. 2). Like the Galapagos, the Coachella Valley is an archipelago, although of mobile sand dunes rather than stationary islands, which have the same effect of fostering evolution of unique species. This is part of the reason why the Coachella Valley has seen great effort to address endangered species conflicts. Another reason is that humans were never able to make much of a living on the valley’s sand and rocky alluvium, in an area that was among the hottest places in North America and receives less than three inches of rainfall annually. These conditions also proved an effective barrier to exotic species that accompanied recent settlers, the weedy plants, insects, and animals from Europe



Fig. 2 Metal sculpture of the Coachella Valley (NW orientation), photographed by Bruce Goldstein at the “Living Desert” outdoor center in Palm Springs, December 1999

and Asia that devastated ecosystems in wetter and cooler parts of California.

This began to change with the construction of the Coachella canal in 1948, which brought intensive commercial agriculture to the southern part of the valley. Urban development began around the same time in the City of Palm Springs and moved southeast along highway 111, the main commercial strip in the valley (Fig. 3). The permanent population of twelve thousand in 1940, grew to 130,000 by 1980, 230,000 in 1990, and 318,000 by 2000 (Singer 2001), with many more staying only during the cooler winter months. This rapid increase in population, approaching five percent a year, has regularly placed the valley among the fastest growing areas in the state, with a 38% growth rate during the 1990’s compared to



Fig. 3 Map showing cities of the Coachella Valley



Fig. 4 A stabilized sand dune in the Coachella Valley, photo courtesy of CVAG

California’s overall increase of 13% (Singer 2001). The area went from wilderness to adult playground, as celebrities like Frank Sinatra and Bob Hope settled here, thousands of others bought vacation and retirement homes attractively laid out amidst heavily irrigated golf courses, and Mexican migrants came to create and maintain these amenities and perform agricultural work.

Once rapid development began, buildings and roads blocked the passage of sand and downwind dunes either blew away or stabilized by developing a hard crust (see Fig. 4). Sand dune-dependent species began a steep decline, including the Coachella Valley fringe-toed lizard (see Fig. 5). Originally found over about half of the valley floor (about 267 square miles), by 1980 about three-quarters of the fringe-toed lizard’s sandy habitat was lost. Chances for survival were growing faint and dune species had few champions. People came to the valley principally to relax and play golf, and rarely took time to appreciate



Fig. 5 The Coachella Valley fringe-toed lizard, photo courtesy of CVAG

the subtle pleasures of the desert landscape close at hand. In the early 1980's the valley did not have a single membership chapter of a major environmental group (Bean and others 1991). The fringe-toed lizard and other dune species did have the support of a handful of local biologists who followed their decline with alarm as many of their favorite research sites were lost to development and habitat degradation.

The Lizard Plan

The fringe-toed lizard had one other ally, the Federal Endangered Species Act (ESA) and its California equivalent. In 1980, local biologists successfully petitioned the U.S. Fish and Wildlife Service (FWS) to add the fringe-toed lizard to the endangered species list, despite business interests' arguments that protecting lizard habitat would choke off development. Three years later, developers proposed to build a golf course and country club squarely within the lizards' twenty square miles of designated critical habitat. Ecologist John Reynolds¹ at the University of California Riverside's Deep Canyon Desert Research Center organized other local biologists to assemble survey information that challenged the developer's assurances that no fringe-toed lizards occupied the development site. The costs of losing this conflict were high for both sides, creating what Reynolds called a "balance of terror". The two sides began to meet together in what they called the "lizard club" to try to create a habitat preserve big enough to ensure the survival of the lizard. According to county supervisor Corky Larsen, having developers work with Reynolds was "... kind of like Richard Nixon going to China."²

As the lizard club was beginning these negotiations, Congress amended the ESA in 1983 to allow private landowners and local and state public jurisdictions to regain some control over their restricted land. "Take" of federally endangered and threatened species³ could be permitted if losses were minimized and fully mitigated. The Services issued a permit for this "incidental take" in exchange for a commitment to abide by the terms of a habitat conservation plan (HCP).

The lizard club agreed to use the HCP program to structure and ratify their agreement. Reynolds proposed that the HCP mitigation site be a 13,000 acre parcel located

in an unincorporated and sparsely settled area of Riverside County. The local biologists were attracted to the parcel because it had a large lizard population, was located in an area where sand still blew in freely from the mountains, and was isolated from neighboring development. Representatives of the nine Coachella Valley cities noted that the area was not attractive real estate and didn't need re-zoning. In 1986, after 3 years of preparation, the Fringe-toed lizard HCP was adopted by Riverside County and the nine cities, and a 30 year incidental take permit was issued by the FWS and the California Department of Fish and Game.

Need to Expand the Plan

By the early 1990's, the HCP had largely been implemented according to plan. Local governments reliably collected mitigation fees, which were combined with federal contributions to acquire nearly all of the Coachella Valley Preserve. The preserve area was considered a tourist destination, with the potential to become a "Central Park" that would remain after the surrounding desert had been developed. The scientific virtues of the plan were noted by conservation biologists (Noss and others 1997). Even nature seemed to approve of the HCP, as sand dunes in the Coachella Valley preserve expanded after they were fenced and guarded (Schweik and Thomas 2002).

Over this time, John Reynolds forged a close working relationship with ecologist Charles Stone, who had been hired to manage and monitor the preserve. Along with Stone's research associate Dan Sickles, these local biologists developed a reputation throughout the valley for scientific rigor as well as political pragmatism, and their opinion was solicited during nearly every conservation initiative or conflict in the valley. Despite the smooth implementation of the fringe-toed lizard HCP, the local biologists became steadily more concerned over whether the HCP could ensure survival of the fringe-toed lizard, let alone protect all of the valley's sand-dependent species. An annual lizard count conducted by Charles Stone revealed dramatic population swings that were correlated with rainfall variation, suggesting that lizards could be wiped out by a succession of dry years. The local biologists also concluded that sand flow could be blocked if a few buildings or trees were placed to the west of the preserve. Fixing these deficiencies wasn't going to be easy. Modifying an HCP had never been tried, and forcing changes on the jurisdictions or petitioning the Services to list other species in the valley would be costly, uncertain, and highly divisive. Even if a raft of additional species were protected, they concluded that the resulting habitat protection regime would be a patchwork of single-species protection efforts, spatially incoherent and economically inefficient.

¹ John Reynolds is a pseudonym, as are all the names of SAC members in the paper.

² Interview held 6/14/99.

³ Species "take" is broader than simply killing an individual of a protected species—it is defined in the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct".

Clinton's HCP Push

Once again, federal endangered species policy provided a way out of this dilemma. In the early 1990's, Clinton Administration Interior Secretary Bruce Babbitt set about making HCPs the centerpiece of the administration's strategy to save the ESA from evisceration. The "sage brush rebellion" of the Reagan era had metamorphosed into the "wise use movement", a loose confederation of ranchers, miners, public lands recreationists, and land-owners who promoted legislation to require federal compensation for regulatory taking of private property, lobbied against funding for endangered species research, and challenged federal resource management in the field through anonymous acts of sabotage or by claiming local authority over federal land (Echeverria and Eby 1995). Bills to weaken the ESA were introduced, boosted by the deregulatory "Contract with America" that propelled the 101st Congress to power. Babbitt needed to change the way that the ESA mobilized an increasingly powerful opposition.

Allies of federal endangered species protection also favored taking a different approach to endangered species protection. Continuing controversy kept the FWS's budget from being supplemented despite an ever-increasing workload, so only about 40% of species had an approved recovery plan and thousands of species were denied federal protection because of budgetary constraints on processing listing applications (Noss and others 1997). Funding decisions were dominated by the charismatic appeal of species as well as the level of conflict with local interests (Metrick and Weitzman 1996). On federal land, only about twenty percent of listed species were improving while on private lands only three percent were recovering (Wilcove and others 1996). Some advocates suggested that the ESA's single-species focus and prohibitive "command and control" powers were a regulatory anachronism (Cheever 1996). Babbitt's sought to reduce political threats by promoting HCPs to the ESA's most motivated opponents, offering them a collaborative alternative to the ESA's prescriptive constraints and even turning them into advocates of increasing Service budgets in order to efficiently process their proposals. Once in place, HCPs would also reduce landowner incentives to practice a "scorched earth" strategy on habitat under their control (Wilcove and others 1996).

The HCP provisions were already in place—the problem was that the federal government could only process and approve HCP permit applications. Writing plans was up to landowners and state and local jurisdictions, and they had shown little interest in embarking on these expensive and uncertain planning processes. Babbitt chose to jump-start the program, which was only averaging one or two plans a

year in the early 1990's, by developing an HCP handbook, streamlining plan review, providing applicants with assurance that a permit would guarantee that there would be "no surprises", and providing funding for HCP preparation, which could cost over a million dollars for a large-scale, multispecies HCP (MSHCP). He directed regional FWS offices to promote HCP preparation and assign experienced staff to assist.

Coachella Valley's Multi-Species Plan

In league with the Coachella Mountains Conservancy, an open space conservation trust, local biologists decided to present a choice to the county and the nine valley cities. Either the jurisdictions would have to endure a parade of newly listed species and a never-ending series of regulatory restrictions and time-consuming planning processes, or the jurisdictions could eliminate the problem by preparing a MSHCP. The local biologists had to make an energetic case, since the Coachella Valley would be the first HCP permit holder to re-visit and extend their agreement, and would be doing so without the immediate crisis that motivated most HCP planning processes (Goldstein 2004). However, they had acquired influential allies over the last decade of HCP implementation, including the director of the area's Building Industry Association and many key elected officials, some who served on the board of directors of the Conservancy. In September of 1993, the county jurisdictions agreed to scope the MSHCP, although they didn't provide any funding. For the next 3 years, the Conservancy raised money to support the local biologists' preliminary assessment, which argued that an MSHCP would reduce regulatory oversight and address deficiencies in the original HCP. Based on this assessment, the cities and county gave the go-ahead to apply for federal planning dollars and draft the MSHCP in 1996. A stakeholder steering committee was convened to oversee a scientific advisory committee (SAC) that would map species distributions, assess potential impacts, and develop alternative designs for the multispecies habitat preserve. Stakeholders would then select a preserve design and agree on a funding mechanism to purchase and manage lands, and Conservancy staff would draft a written plan for public review. Finally, state and federal wildlife agencies would review planning documents and issue an incidental take permit for covered species. The Conservancy estimated that this effort would cost \$300,000, a relative bargain compared to San Diego County's MSHCP, which had already cost \$3.2 million and was still years from permitting.⁴

⁴ As Alagona and Pincetl (2007) note, the eventual cost of the Coachella Valley plan exceeded \$2 million.

The regional offices of the U.S. Fish and Wildlife Service (FWS) and the California Department of Fish and Game (DFG) were strongly in favor of an MSHCP in the Coachella Valley. A new plan would enable them to deliver on the new administration's agenda, allow them to correct deficiencies in the Fringe-toed lizard HCP by increasing fee collection to acquire additional habitat, and reduce their workload of biological opinions and enforcement actions by devolving authority to the Valley jurisdictions, while retaining agency oversight through the threat of permit revocation. Regional staff were delighted that the local biologists were promoting and raising funds for the MSHCP, especially since an earlier attempt had failed when the Coachella Valley jurisdictions were unwilling to join forces with their fractious and litigious brethren in western Riverside County to pursue a county-wide initiative.⁵ Federal biologists Bill Loring and Dan Tyler and state biologist Jane Pettigrew were assigned to attend the monthly SAC meetings (these three biologists will be referred to as the "regulatory biologists", and their employers collectively as the "Services"). Pettigrew's biography illustrates the diversity of knowledge and experience that the three agency representatives brought to the SAC. After receiving her Masters degree in Biology, Pettigrew became a self-described "desert rat", living and working in the deserts of southern California after being hired by DFG in the mid-80's. Over her career she had responsibility for ensuring the well-being of endangered and threatened fish, amphibians, and reptiles, including the Coachella Valley fringe-toed lizard. In 1989, Pettigrew was assigned to work principally on large-scale endangered species planning efforts, including HCPs and recovery planning.

Like the local biologists, the regulatory biologists expressed a fierce ethical commitment to species protection, a personal attachment to the Coachella Valley, and a belief that completing the HCP was a good way to express these values and further their careers. There were also important differences between the local and regulatory biologists. None of three regulatory biologists had been beneficiaries of the virtuous cycle of increasing trust and responsibility garnered by the local biologists over the past 20 years. The highlight of their experience in the Coachella Valley had been bitter feuding with the cities of the valley over the impact of much-coveted golf course developments on endangered Peninsular Big Horn sheep. While the Big Horn sheep population was in rapid decline, there was no agreement about the cause of this decline (and hence the remedy). For the regulatory biologists, the natural

dynamics of the Coachella Valley were as wily and unpredictable as its social dynamics.

The SAC

Over 4 years, the SAC met for one or 2 days a month to guide Conservancy staff in the design of a habitat preserve. The SAC either developed or commissioned GIS data layers depicting soils, vegetation, and other features and combined them to yield a habitat suitability model for each covered species. They established criteria for reserve design and connectivity, and assisted in preparation of seven preserve alternatives, which they winnowed down to two for consideration by the stakeholders. Despite delay, stakeholders waited patiently, relying on the SAC. As the influential director of the area's Building Industry Association put it,

The reason that I've been able to keep my folks involved and satisfied is resting upon the Scientific Advisory Committee. The whole understanding all along is that this would be a scientific plan, not one that was a horse trading plan. Science is science, and it should not be shaped.⁶

Anticipating the need for formal approval by the regulatory agencies, Conservancy staff and local biologists pressed the regulatory biologists to define criteria for receiving incidental take coverage, which the regulatory biologists refused to provide. Instead, regulatory biologists repeated that this criteria could only be provided through what they called an "iterative process" that required consultation among a larger group of agency biologists. Since SAC decisions required consensus, Conservancy staff kept the process moving by recording that the regulatory biologists never actually rejected the approach proposed by the local biologists. Local biologists and Conservancy staff also attempted to bolster scientific credibility of their preserve design by twice hosting three nationally recognized conservation biologists for 2-day evaluations of the design. After both meetings, a report authored by the Conservancy staff described the scientific reviewers' concurrence that the SAC's methodology was sound.

By early 2000, Conservancy staff and local biologists were putting finishing touches on two habitat preserve alternatives, stating that the MSHCP would soon be submitted for approval. One local biologist commented that, "We could have sat down 4 years ago and sketched out the preserve design we have now, after 4 years, but we needed to be legally defensible and credible to critics".⁷ The local

⁵ Source: Minutes of the Coachella Valley Association of Governments, October–November 1991.

⁶ Interview held 12/19/01.

⁷ Interview held 4/13/00.

biologists were pleased that they had combined a rigorous GIS assessment with their field knowledge in a way that they felt would satisfy any external critics. The problem was, not all of the critics of their work were external to the SAC.

The Letter

During the early months of 2000, the three regulatory biologists met privately to review the preserve design and prepare a comment letter, which they sent to the Conservancy in April 2000. Their principal recommendation was to add sixteen additional areas to the HCP's multi-species habitat preserve. Each rationale that the letter provided was central to the purpose of the preserve system—to protect habitat, ensure the maintenance of the sand flows needed to maintain habitat, and facilitate the movement of species between habitat patches. Yet nearly all these additional sites were rejected on first consideration by local biologists during the contentious May 25th SAC meeting. Behind each rejection lay the local biologist's conviction that each additional area failed to meet two key criteria:

1. Does the site contribute toward meeting threshold requirements for species viability?
2. Does the site contribute toward the composition of three distinct sites for each species?

These two binary questions applied concepts and techniques that the local biologists adopted from population genetics and landscape ecology. The first of these was "population viability assessment" (PVA), a technique to calculate how many individuals of a species are required in a preserve in order to maintain genetic diversity and bounce back from depletion of natural variation and environmental stress over the passage of centuries. Since the local biologists were unable to gather the demographic data required to calculate a PVA for any of the species in the Coachella Valley, they performed what they occasionally called a "mental PVA" instead. As one local biologist described it:

We said, 'Well, 5000 individuals for a vertebrate.' Certainly that many for a vertebrate would be a sufficient viable population. And so in our minds we were able to calculate what area you would need to provide habitat for that population size.⁸

The other criterion to preserve three distinct sites was determined similarly. Local biologists decided that preserving three distinct sites was a conservative goal, and

they used their judgment to determine how far apart to space these sites.

At this meeting the regulatory biologists gave the local biologists what they had been asking for years, the Services' guiding principle for habitat preserve design. The regulatory biologists defended their addition of new preserve areas in order to protect habitat to the "maximum extent practicable", a principle derived from the language of the Endangered Species Act itself.⁹ This newly articulated principle was quite different than the local biologists' commitment to conserve what was "necessary and sufficient" to ensure the survival of covered species. Announcement of this new principle did little to mollify local biologists, who recognized that conserving as much as was "practicable" undercut their argument that only three core habitat areas were "necessary and sufficient" to ensure the survival of each covered species. As one local biologist complained at the meeting, it was as if the regulatory biologists were saying,

... 'Why not throw it in'... but if you use that argument it becomes a slippery slope, because you say why not protect every empty lot that is left, because there is probably some soil invertebrate that lives there.

In response, the regulatory biologists defended their approach as precautionary, given the absence of scientific certainty. As one regulatory biologist put it, "The more area, the more certainty you will have." Another regulatory biologist noted that, "The objective of the letter was to maintain consideration of these areas until there is adequate documentation."

This disagreement highlighted a difference in degree and kind between how local and regulatory biologists addressed uncertainty about the natural world. Confident in their field observations and disciplinary expertise, the local biologists confined their concern to the accuracy and precision of species models and associated data, setting the threshold of their "mental PVA" at a "conservative" 5000 individuals in each of three distinct sites. Regulatory biologists' were much more cautious about predicting the natural order. They noted that other California coastal HCP's had relied on PVAs only to become embroiled in controversies over the value of demographic variables that determined how many individuals of a protected species were adequate to avoid extinction. Given this experience, one regulatory biologist recommended additional preserve

⁸ Interview held 5/24/00.

⁹ In the Federal Endangered Species Act, Section 10(a)(2)(B), 16 USC § 1539, an applicant for an incidental take permit must prepare and submit to the Service for approval a Conservation Plan containing a strategy for minimizing and mitigating, to the maximum extent practicable, the impacts of the take on listed species associated with the proposed activities.

acreage beyond what was required to maintain what one of them called the “magic number” of 5000 individuals per site.¹⁰ They advised against relying on any single theory or method, since scientific theory and practice were subject to change over time. By preserving the “maximum extent practicable”, they reserved the ability to remove sites later if new facts or ecological principles emerged.

Deadlocked and frustrated, local biologists complained to some of the key stakeholders that the regulatory biologists were “trying to preserve everything where it exists today”. Plan stakeholders were nonplussed by the SAC’s disunity, and concerned about finishing the planning process. Their initial reaction to the deadlock over the regulatory letter, as voiced by the planning director of one of the desert cities, was “Run that by me again?” The Director of the Coachella Valley Building Industry Association questioned why the regulatory biologists would challenge the judgment of local biologists:

I don’t understand Fish and Wildlife or Fish and Game and their position. We have a very well made up and educated Scientific Advisory Committee who has lived here for years, who is on the ground daily, and who understand everything that goes on in the valley. And when they say something is not really viable for a critter or plant, how can you guys who come here every once in a while and supposedly have the same education, say, ‘No. You are wrong. This is the way it should be.’ I am sorry. I am having trouble understanding that.

The stakeholders could contribute little to settling the dispute, other than to advise the SAC to work out their differences. As one of the city planning directors put it:

The main thing is that the cities aren’t in a position to start arbitrating between scientists arguing amongst each other. This whole thing is going to degenerate real quickly if that happens.

By mid-2000, the two factions of biologists had ceased making any progress on resolving the remaining areas proposed in the regulatory letter, which added an additional ten percent of land to the local biologists’ original preserve design (see Fig. 6, which contrasts the two preserve design alternatives from this time).

Deadlock turned to denunciation as both factions struggled to align new scientific allies and plan stakeholders with their preferred preserve design. When regulatory biologists announced at the July 2000 SAC meeting that they had contracted U.S. Geological Survey geologists to conduct an assessment of sand sources, local biologist John Reynolds

responded: “We haven’t been discounted, we’ve been rejected entirely. That’s what I get out of your proposal. And before I burn the rest of my bridges I’m just going to shut up, but I think you guys have really blown it. Excuse me. I’m leaving.” As he got up and pushed his chair back to the table, one regulatory biologist said to him, “Don’t interpret it that way.” He responded “I have” as he walked out the door. Defending Reynolds in the ensuing discussion, local biologist Charles Stone told the regulatory biologists that, “You haven’t really given us any other options.”

Months later, after the U.S. Geological Survey geologists presented their findings, the regulatory biologists were convinced that the sand source analysis had introduced enough uncertainty to justify adding all ten sites to the preserve. One confided to me that, “Those were just huge killer issues to resolve with the SAC, and they {the local biologists} didn’t argue them. They asked some weak questions, but didn’t come close to getting these guys to change their mind on including these areas that the SAC thinks aren’t necessary... Things are falling into place.” However, the sand source study only strengthened the local biologists’ commitment to their preferred preserve design. Emphasizing the geologists’ finding that significant sand deposition occurred during unusually intense storms, the local biologists argued that their observations of sand deposition pathways were more accurate than the geologist’s historical projections.

Regulatory biologists also funded a scientific review of the SAC’s preserve proposal to bring in the opinion of outside experts on what one termed “the provincial Coachella Valley focus.”¹¹ Nine scientists convened for 2 days to listen to presentations and examine plan documents and then left the Valley to prepare a formal report. One local biologist first heard that this report was released from a stakeholder who told him, “Oh, they really slammed you.”¹² He agreed, noting that the report’s suggestion that the SAC had allowed political and economic factors to influence their judgment “...puts a shadow on our character.” At their next SAC meeting, local biologists discussed how this report was grounded in the reviewer’s unfamiliarity with Coachella Valley ecology, such as their recommendation to include the “Big Dune”, a site on the regulatory biologists’ list of preserve additions:

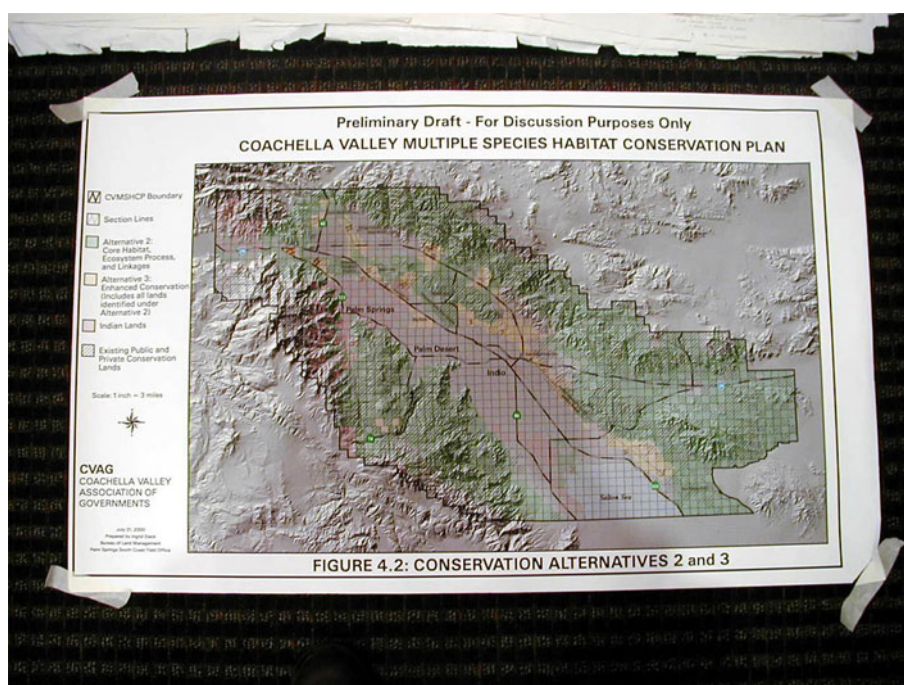
They don’t get it. I’ve been talking to naturalists and biologists who have lived in the Valley their whole adult lives. I was talking to one over the weekend who went out to the Big Dune... to get some photographs of fringe-toed lizards.. and couldn’t find one anywhere. He said, ‘It used to be that my feet would

¹⁰ Meeting between regulatory biologists and consulting team in Carlsbad, CA 6/20/00.

¹¹ Interview held 5/10/01.

¹² Interview held 5/1/01.

Fig. 6 Map containing the areas that both local and regulatory biologists agreed should be in the preserve (*green*) and additional areas proposed by regulatory biologists (*beige*), created July 21, 2000 by CVAG and photographed in June 2001 by Bruce Goldstein



sink into the sand when I walked out there. Now I'm standing on top of the heavy crust.' And I said, 'Well, yeah, that's exactly what is going on out there. The place is getting stabilized.'¹³

After the meeting, local biologists prepared a point-by-point rebuttal of the scientific reviewer's report and presented it to plan stakeholders. As one local biologist noted afterwards, "They all said, 'Gee, it sounds like you're just fine. We're in your camp all the way.'"¹⁴ Frustrated that their investment in the scientific review hadn't resulted in any changes, one regulatory biologist noted to me, "It's apparent that they're not taking a hint. They wouldn't hear from us initially, and now from the SRP {scientific review panel}. Now they're going to have to be hit upside the head with something even more tangible."¹⁵

By the middle of 2001, convinced that they could make no further progress on narrowing their remaining differences, the local biologists began to hold SAC meetings without the regulatory biologists present, developing a detailed rationale for why the SAC was adopting a preserve alternative that excluded the contested additions. As one local biologist noted, "In the beginning we all weighed into this thinking we would get consensus. But there was a point at which the wildlife agencies made it clear that there wasn't that kind of collegial process on their side. At this point we are concerned that we will never get there and we are losing habitat as we wait."¹⁶ Regulatory biologists

wrote a letter to the Coachella Valley County Commission warning that these "secret meetings" were a mistake. Undeterred, the local biologists scheduled meetings with county and cities to familiarize them with the conservation areas that they had chosen. The regulatory biologists responded by vetting their own version of the habitat preserve with the jurisdictions, and negotiated with Riverside County to include one of the ten contested sites in the habitat preserve in exchange for permission to widen a busy road that crossed the site. The local biologists were outraged by what they saw as a dangerous precedent for negotiating preserve sites rather than providing a scientific rationale, and they kept this site out of their preserve design, arguing that it was of little ecological value.

Rejoining the SAC in October 2001, the regulatory biologists presented new permitting requirements, arguing that these supported adding the ten contested sites to the preserve. When the meeting facilitator attempted to initiate a discussion about what he termed "the genesis of differences" among the two factions, a regulatory biologist countered that it was too late to have that kind of conversation, and that their position was non-negotiable. When news of this development spread among the stakeholders, leading supporters of the plan in the Valley decided that they had to end the deadlock. Most blamed the regulatory biologists for the inability to finish the plan. Jim Sullivan, the director of environmental planning at the Coachella Valley Association of Governments, characterized the regulatory biologists' actions as a "stab in the back", in

¹³ Interview held 5/1/01.

¹⁴ Interview held 5/1/01.

¹⁵ Interview held 6/1/01.

¹⁶ Interview held 6/16/01.

which a “... bunch of strangers from outside the valley were trying to tell our experienced biologists what needed to be done.”¹⁷ One regulatory biologist later noted:

There were complaints registered at higher levels in the office here. Some of them were outright fabrications. You know, horror stories. Some of them had no basis. Some of them were grand exaggerations... I think that’s probably a natural evolution of things that even though it affected me personally.¹⁸

Plan stakeholders met with top officials of the Services and agreed to dissolve the SAC and hand over final decisions on preserve design to a committee of key stakeholders and senior agency staff in order to wrap the MSHCP process up by the end of the year. As one local biologist described it, everyone on the SAC was being told, “You’ve accomplished what you can and now it’s time to be done. Okay, you can now go away.”¹⁹

However, the plan took nearly seven more years to finish, and one of the cities dropped out of the planning process altogether. During this time, state and federal wildlife agencies continued to rely on the regulatory biologists for advice about the plan and the jurisdictions remained unwilling to commit to a habitat preserve design that did not have the approval of the local biologists. For instance, in November 2001 county commissioner Corky Larsen decided to include all of the remaining contested preserve areas in the preserve because it was, as she put it, “windy God-forsaken land”²⁰ that was already zoned open space. However, local biologists met with her and convinced her that these areas added little to the plan and greatly increased acquisition and management costs. As she explained it:

The Louisiana Purchase was considered a huge amount of money. Whatever we paid today will be considered cheap one hundred years from now. My concern was not the cost. My concern was doing things right, and what I heard them {the local biologists} saying was that these particular areas are damaging the plan. That’s significant.

What was at Stake?

The members of the scientific advisory committee had overcome many obstacles over the 10-year planning process of the Coachella Valley MSHCP, from technical snafus to funding shortages to political disinterest. In this

light, why were they unable to resolve their differences over the additional habitat preserve sites proposed in the regulatory biologists’ letter? After all, the disputed sites represented a trivial proportion of the total area that both sides agreed should be part of the habitat preserve. Given that they had worked so long on the MSHCP and were so close to agreement, was there something important at stake in this persistent and destructive disagreement?

Alagona and Pincetl (2007) suggest that the regulatory biologists were unable to build trust and bridge their scientific differences because the local biologists were suspicious of state intervention and the regulatory biologists were distant and disengaged. In the heat of the controversy, the explanations offered by the SAC biologists were similar to Alagona and Pincetl’s account, although with a stronger emphasis on personal and professional inadequacies. The local biologists blamed the dispute on the regulatory biologists’ lack of commitment to anything beyond bureaucratic imperatives, while the regulatory biologists’ accused the local biologists of scientific elitism. However, these accusations were not borne out by my interviews and observation. During meetings and field trips conducted after SAC meetings, regulatory biologists demonstrated a commitment to species protection, a personal attachment to the Coachella Valley, and a belief that completing the HCP was a good way to express these values and further their careers. Their years of consistent attendance at multi-day MSHCP meetings was greater than many other HCPs that I examined, where regulatory staff with the least seniority were often assigned responsibility for participating in extended stakeholder processes (Goldstein 2004). For their part, the local biologists did not distrust federal agencies or ground their practice in an uncompromising idealism. They were long accustomed to working with federal officials and practicing the “art of the possible” by accepting compromises rather than maintaining a principled position that would yield little benefit for conservation.

Institutional Isomers

If an explanation based on the biologists’ own critical assessment is implausible, what can explain their incapacity to agree? To answer this, I first relate their deadlock over preserve design to their respective understanding of MSHCP’s institutional context. Both factions referred to three distinct intervals:

- Permitting, including plan preparation, submission by the jurisdictions, and approval by the wildlife agencies;
- Legal defense, particularly court challenges filed after the plan was approved; and
- Implementation of the MSHCP.

¹⁷ Interview held 12/6/01.

¹⁸ Interview held 12/21/02.

¹⁹ Interview held 12/20/01.

²⁰ Interview held 12/21/01.

Within these intervals both biological factions described the same organizations: the cities and county, environmental and development advocates, the courts, and a preserve management agency, with the Services providing oversight. However, the regulatory and local biologists described these organizations within a radically different cultural, natural, and epistemic context. To borrow a metaphor from chemistry, their institutional expectations were isomeric. Just as isomers are differently shaped molecules with the same molecular formula, each group of biologists imagined a future with identical organizational components in different institutional configurations.

The local biologists' isomeric conception of the valley evoked a kind of *peaceable kingdom* in which local jurisdictions, environmental groups, and development interests support and sustain the MSHCP. This mutually cooperative ethos between human and natural communities reflected the local biologists' experience over a generation of consensual endangered species management in the Coachella Valley. During permitting, stakeholders would look to the local biologists to personally guarantee that the proposed habitat preserve would protect imperiled species while not requiring land conservation in excess of scientific prudence or regulatory requirements. Local biologists dismissed the possibility that a legal challenge to the plan could prevail because no one could mount a successful challenge to their expertise. Finally, they would guide implementation of the plan just as they had done for the Fringe-toed lizard HCP habitat preserve, as long as the preserve had defensible boundaries and compatible adjacent land uses, an impossibility if the ten disputed additions were added to the preserve. The local biologists could even envision the convergence of society and nature over the longest time frames, invoked in the statement one local biologist made that "... people die out, buildings go away, and lizards maintain what happens over the long haul."²¹

For the regulatory biologists, uncertainty about society and nature meant that even imagining conservation outcomes over this apocalyptic timeframe was inconceivable. The valley's political jurisdictions were united only by a shared commitment to pursuing their individual welfare. They would have to be closely watched and held to the conditions of the incidental take permit, which they surely seek to covertly violate. It was imprudent to accommodate specific interests in the SAC preserve design, which was merely the opening bid in bilateral negotiations between local jurisdictions and regulatory agencies over how much money and land was required. During inevitable legal challenge, a successful defense would turn not on who could muster better experts but rather on whether the Services could demonstrate that permitting decisions were

well enough documented to not be "arbitrary and capricious". Finally, long after everyone involved in drafting the HCP retired, the jurisdictions would still be advocating development on critical preserve lands in private hands. The Services ability to defend the preserve's integrity required an explicitly documented rationale, not the interpretive skills and memory of local biologists. In contrast to the regulatory biologists' peaceable kingdom, the Service's institutional isomer is *red in tooth and claw*, a valley of contingency, strategy, and uncertainty.

Embodied and Distributed Knowledge

While each faction of biologists was acutely aware of their responsibility to maintain the circulation of scientific knowledge through time and across institutional space, each faction had a very different conception of the character of scientific knowledge required to flow across these two isomeric institutional networks. For the local biologists, reducing the viscosity of the flow of science through time and institutional space depended on being the locus of scientific authority across every venue of scientific analysis and decisionmaking. They considered themselves to be the only scientists who could maintain the trust and confidence of the local jurisdictions, vanquish legal challenge by appearing in court with, as one local biologist put it, "...one hand on the Origin of Species",²² and effectively monitor and manage the habitat preserve. The local biologists embodied scientific knowledge, after decades of close observation and physically engaged work within the desert in close association with the other biologists of the Coachella Valley. Their scientific authority was reinforced by their longstanding position as the arbiters of conservation issues in the valley, where they had become personally associated with high standards of scientific accuracy and integrity. Ultimately, their endorsement of a scientific claim was a guarantee that it met the standards they applied to their own scientific practice. In their view, their own scientific judgment and the state of the science were inseparable.

In contrast, the regulatory biologists held that the flow of scientific knowledge across time and institutional space relied precisely on the degree to which scientific claims was disengaged from close association with individual scientists, including themselves. Scientific truth was too contested and changing to rely on a single source, and the unpredictable and wily nature of social relations in the Coachella Valley made it unwise to base a regulatory regime on a fragile consensus about the reliability of a few scientists. Rather than rely on embodied expertise, the

²¹ SAC meeting, 10/27/00.

²² SAC meeting, 5/5/00.

regulatory biologists sought to maintain the unimpeded flow of scientific knowledge across institutional arenas through careful documentation and citation. In this way, the transferability of scientific knowledge across their institutional network was guaranteed not through trusted individual relationships but through explicit conformity with standardized research methodologies and through association with reputable organizations such as scientific journals or state and federal government agencies. The regulatory biologists were acquainted with a broad range of often disharmonious scientific claims, accustomed to dueling with wily and untrustworthy county and city leaders over the scientific basis for regulation, and lodged within bureaucracies where scientific standards were beyond their control and often impossible to know in a timely fashion. This experience had attuned the regulatory biologists to ambiguity and contestation across disciplinary specialties and paradigms, as well as among sponsoring organizations and interests, including their own agencies. Their scientific abilities lay precisely in evaluating how knowledge claims could withstand the scrutiny of other scientists across a range of perspectives, and so they were committed to a knowledge practice that was distributed across the scientific community rather than embodied in their own education and field experience.

Destroying the Plan in Order to Save it

Each faction of biologists on the SAC assessed the proposals of the other faction on the disposition of the ten contested preserve sites using their own set of presuppositions about the institutional culture of the Coachella Valley and the appropriate kind of science that could circulate within it. This exchange crystallizes the distinction between the two sides:

Regulatory biologist: “You know, if you really boil it down, there were a lot of unsupported assertions.”

Local biologist: “By the experts in the field.”

Regulatory biologist: “Right. And we’re trying to get beyond that.”

There was superficial agreement here, along with profound disagreement about what constitutes credible knowledge. The grounding of the embodied knowledge of the local biologists within a natural and social order that I have typified as a *peaceable kingdom* and the distributed knowledge of the regulatory biologists within nature and society *red in tooth and claw* suggests how social relationships and forms of engagement with the natural world are conditions of possibility for scientific judgment. This conception of “situated knowledge” (Haraway 1997) contrasts with the concept of a universally valid science, a

“view from nowhere” where facts can be objectively determined. However, neither the regulatory nor the local biologists nor the Conservancy staff ever discussed their conflict in these terms, despite an appeal very late in the dispute to examine “the genesis of differences” among the two factions. Instead, each faction held to the position that the other group of biologists was proposing a habitat preserve design that would be impossible to approve, defend in court, create, and manage. Making any concession was unthinkable. Every proposal that the other biological faction put forth would cause the MSHCP to fail, so both local and regulatory biologists refused to offer or entertain a compromise, since no MSHCP at all was better than a dysfunctional MSHCP.

What appeared on its face to be a small disagreement over the status of ten preserve areas was a struggle over the organizational structure and institutional dynamics of species conservation in the valley. In this light, it is possible to understand why both the regulatory and local biologists would risk undermining the entire HCP planning effort rather than give ground. What was at stake in this dispute was their capacity to act effectively as scientists in the valley both now and into the future, and ultimately their ability to ensure the survival of endangered species in the Coachella Valley by setting into motion a natural and social order that was amenable to the particular way they did science. Their resistance to each other’s proposals was founded on this essential tension.

Without any appreciation for the position held by the other side, each group of biologists was reduced to speculating about how the other side’s personal and professional defects motivated such a destructive course of action. Throughout their dispute over the ten additional preserve sites, both the regulatory and local biologists were at least in firm agreement on one thing: the other biologists were advocating a scientifically dubious HCP that could not be permitted, legally defended, or effectively implemented. While this mystifying, perverse and destructive behavior was attributed to bureaucratic disregard and scientific arrogance, I suggest that each sides’ intransigence was actually grounded in their dedicated professional practice and deep commitment to endangered species conservation.

The Weakness of Tight Ties

The MSHCP was finally approved in October 2008, nearly 7 years after the SAC was disbanded and 19 years after planning efforts began, an unprecedented duration for the over six hundred HCP’s that have been permitted (Goldstein 2004). Returning to the questions raised by Alagona and Pincetl (2007), why did the plan take so long to

complete, and what can we learn about how to prevent this from happening elsewhere? While Alagona and Pincetl suggest that the MSHCP's local scientific support helped speed plan completion, I identify it as a principal cause of deadlock. Tight ties between collaborative governance and expertise were integral to the crisis in the MSHCP, just as they were integral to successful implementation of the original plan and made the MSHCP planning effort possible. In this remainder of the article, I discuss this weakness of tight ties between science and governance, a slightly tongue-in-cheek inversion of Granovetter's (1973) analysis of the cost of "bonding" as opposed to "bridging" social capital. I conclude by addressing Alagona and Pincetl's second question and suggesting a variety of approaches to scientific mediation that can help circumvent crises like these and even achieve more than resolving disputes.

The effectiveness and durability of the fringe-toed lizard HCP in the early 1980's hinged on determining what knowledge should inform decisionmaking, who would provide that knowledge, and what institutions would require that knowledge. Taking a landscape disordered by competing needs to protect habitat and pursue development, the FTL plan neatly divided occupied from unoccupied habitat, needed from unneeded sand sources, and protected from unprotected lands. This served the valley's need for transparent and governable spaces (Scott 1998) required by lizards seeking undisturbed habitat and developers seeking rapid approvals and surety for their investments. Local biologists created and maintained this settlement, while deriving support and credibility from this relationship. The agreement's fairness and legitimacy rested on local biologists' reputation and field experience, rather than statistical measures or other more impersonal forms of validation. Local expertise and trust and affinity between stakeholders were mutually supportive throughout plan implementation. Over time, the landscape was remade in the image of the plan, effectively erasing the contingencies of plan negotiation.

Ten years after the HCP was approved, the MSHCP planning process slowly began. As Alagona and Pincetl (2007) suggest, greater stakeholder engagement was associated with quicker progress in other HCPs. However, other plans were usually initiated when species protection poses an imminent obstacle to development or resource extraction, a condition often referred to as a "train wreck". Over 5 years, local biologists enlisted stakeholders in the new plan by providing early warning of future train-wrecks, drawing on their tight ties within the Coachella Valley. Once the planning process got stakeholder approval and sponsorship, local and regulatory biologists engaged on the SAC. The two groups of biologists were not hampered by prior disagreement or mistrust, and both groups were

committed to species conservation, willing to participate in frequent meetings and capable of understanding the plan's technical complexity. The situation's novelty lay in the SAC itself, an unusual setting for interaction requiring collective deliberation and consensus, instead of coordination across distinct arenas of scientific practice.

The local biologists' tight local ties became a liability for continued plan progress. After years of painstaking assembly of data on species location, ecosystem processes, and habitat conditions, local and regulatory biologists became deadlocked, unable to agree on what areas to include within the multispecies habitat preserve. Each biological faction was unwilling to accommodate the other's position on the ten contested sites because even a small change in the geographic contours of the habitat preserve could make it difficult for either faction to navigate the plan through imminent approval by local jurisdictions, potential legal challenge in a few years, and plan implementation over the next hundred years and beyond. Their institutional assumptions were isomeric, radically different despite being assembled from the same organizational parts. The regulatory biologists on the scientific advisory committee did not share in the trust and mutual reliance between local biologists and Valley stakeholders, and their expertise was grounded in the Service's adversarial relationships with those they regulated. For both local and regulatory biologists, ensuring the survival of the valley's native species rested on their ability to extend the social conditions of possibility of their own scientific knowledge and practice. The other group's preserve proposal was factually inaccurate, procedurally and theoretically flawed, and biased. The other group's proposals were also very threatening, with terrible implications for plan effectiveness, career and professional status, and species survival.

Rather than becoming deadlocked because of prior disengagement and mistrust (Alagona and Pincetl 2007), the SAC became mistrusting and disengaged because of the deadlock. The narrowness of their scientific discourse fostered a mutual incomprehension that made their relationship even worse, as they became convinced of their opponent's bureaucratic disregard, scientific arrogance, and even personal malice and incompetence. This is the kind of unintentional transgression that Helen Watson-Verran (1994) archly labeled "epistemological arteriosclerosis", or "hardening of the categories". By only proposing and validating scientific claims that sustained their own authority and legitimacy, each faction unwittingly posed a threat to their counterparts' configuration of knowledge and the social order, initiating a fierce resistance to each other's efforts to resolve the conflict. This mutual intransigence, motivated for reasons that each side considered crucial to the success of the planning effort, was

responsible for adding many years to an already prolonged planning process.

Efforts that each biological faction made to resolve the crisis only hardened their disagreement. Each faction's lack of appreciation of the other faction's motives only confirmed their suspicions that the other faction was negotiating in bad faith and was unconcerned about species survival. Competing efforts of local and regulatory biologists to bring their conception of the social and natural world into being demonstrates that scientific and technical differences cannot be solved independently. As Shackley and Wynne (1996) write, "Validity depends upon whether the world—natural and social—can be restructured and manipulated to accord with and thus 'validate' the tacit models embedded in the technology or knowledge claim." For both sides, the stakes in the dispute over the habitat preserve were high. The deadlock came at a particularly delicate point in the creation of the MSHCP, when neither institutional "isomer" had been firmly established. Both biological factions were attempting to ensure that the MSHCP planning process would foster a social and natural order compatible with their scientific practice. Permitting their opponents to prevail would only establish an institutional precedent that they might never break away from, for as Jasanoff (2004) observed, "Institutionalized ways of knowing become socialized into actors and thus unquestioningly reenacted, because it would be too disruptive to reexamine them openly." Both factions unwillingness to let this happen ultimately led to the dissolution of the SAC, the "center of calculation" (Latour 1988) for all six biologists' attempts to co-produce scientific knowledge and the social order within the Coachella Valley.

Applying Case Lessons

The Coachella Valley MSHCP process attempted to extend an existing HCP in the absence of an immediate crisis. These circumstances are not analogous to the origins of almost all existing HCPs, but are likely to apply to more plans in the future. Fewer first-time HCPs are possible given the near-saturation of these agreements in biodiverse areas of the country (Goldstein 2004), and existing HCPs, many of which were permitted for decades or even centuries, are likely to need modification in response to unexpected outcomes and emergent challenges, such as climate change (Ruhl 2008). Given their success to date in resolving train-wrecks and their longevity, existing HCPs also may become the nucleus for more inclusive forms of collaborative governance, something that is also happening among other collaborative agreements where stakeholders have remain engaged with one another to implement the solutions they had devised (Healey 1997; Innes and others 2007).

Examining this scientific controversy "in the making" (Shapin 1992) rather than relying on retrospective accounts by the protagonists themselves (Alagona and Pincetl 2007) provides a good learning opportunity for these emerging circumstances, allowing us to understand why each biological faction accused the other of engaging in professional malpractice. A controversy is an opportunity to diffract different ways of knowing, producing an image of the effects of difference. This image is one that scientists themselves may not ordinarily see because of their commitment to objectivity and detachment, as well as their need to separate scientific advice from mere opinion or political preference when they engage in the public sphere (Gieryn 1983). Post-positivist approaches such as the advocacy coalition framework allow us to recognize incommensurable differences between ways of knowing and help us to understand why stakeholders shouldn't rely on experts to resolve fundamental value differences. However, loose coupling of science and policy-making doesn't capture the way that expertise and the social order are tightly interwoven and mutually constituted, leaving us with no way to address incommensurable differences through expert collaboration. Examining how forms of scientific expertise are tightly coupled and co-produced allows us to understand the contribution that experts make to creating, maintaining, extending, or changing the social order, which in turn may sustain this expertise. This framework enables us to recognize how interpenetration of science and the social order is integral to expertise, rather than an obstacle to provision of expert advice.

Understanding the dynamics of coproduction opens up a variety of options for collaborating amidst technical complexity. One option is to produce rapid coordination while doing little to bridge underlying differences, while other approaches take more time and dedication and potentially yield more significant and lasting impacts. An example of rapid coordination is provided in a companion analysis of the Coachella Valley MSHCP (Goldstein, in press) that traces how SAC members reached agreement on a Fringe-toed lizard habitat map. Evaluating this map by their own criteria, each faction of biologists created a shared resource that had enough common features to enable coordinated action across their persistent differences and absence of mutual understanding. This shared "boundary object" (Star and Griesemer 1989) held together until the dispute described in this article, when the map's validity was challenged by peer reviewers that regulatory biologists brought in after SAC communication broke down.

Alternatively, a facilitator can take a longer view and cultivate understanding of how scientific differences are grounded in personal and professional stakes that experts have in maintaining their knowledge claims. Open dialogue about what the beleaguered MSHCP facilitator called the "genesis of differences" between ways of knowing may

create willingness to accommodate other forms of knowledge by fostering trust (Kaufman 2009; Innes and Booher 2010). Stakeholders can also be closely engaged in order to bring to the surface the institutional commitments that underlie different knowledge claims. Engaging scientists with stakeholders may facilitate co-production as an adaptive and responsive relationship, a process of constant exchange and mutual stabilization (Jasanoff 2004), rather than a set of static institutional assumptions such as those that divided the two biological factions. This is a more reciprocal approach to “joint fact-finding” (Karl and Susskind 2007), a process that emphasizes mutual learning among and between stakeholders and closely-aligned experts.

Extended beyond a single agreement or dispute, collaborative efforts can in turn catalyze new opportunities for institutional change. One example is the U.S. Fire Learning Network, an effort to enable fire managers to acquire skills and knowledge and develop inter-organizational relationships in order to increase their collective capacity to restore fire-adapted ecosystems (Goldstein and Butler 2009; Goldstein and Butler 2010). Approaches like this take more patience and commitment than even an extended multi-stakeholder collaborative negotiation, since they are linked to the slow processes of identity formation, knowledge production, and institutional transformation. These simultaneous changes, while slow and often arduous to achieve, may be what is required to address challenges that make intractable disputes between stakeholders seem relatively benign by comparison, such as the exhaustion of freshwater supply, peak oil, fisheries declines, and climate change.

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