UNIVERSITY OF CALIFORNIA,
IRVINE

The "Hidden Drought": Water Politics and Ecology Building in California's Low Desert

DISSERTATION

submitted in partial satisfaction of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

in Anthropology

by

Emily Brooks

Dissertation Committee:
Assistant Professor Valerie Olson, Chair
Associate Professor Eleana Kim
Associate Professor Kristin Peterson

2017

DEDICATION

To my husband, Brian.

And to Edie, in this time of struggle.

"This is a book about man's war against nature, and because man is part of nature
it is also inevitably a book about man's war against himself."

Rachel Carson

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

ACKNOWLEDGMENTS

I would like to express the deepest appreciation to my committee chair, Valerie Olson, whose incredible capacity for creativity and insight has been (and, I'm sure, will continue to be) a source of inspiration for me both professionally and personally. Thank you for your mentorship over the years, and for modeling the kind of scholarship and collegiality to which I aspire.

Thank you also to my committee members, Kristin Peterson and Eleana Kim, for their thoughtful engagement with every stage of this research, and for pushing me to ask the hard questions. Without your guidance and expertise, this work would not have been possible.

I have been fortunate also to work alongside colleagues from across the spectrum of environmental studies at UCI. Thank you to Travis Huxman, David Feldman, Susan Coons, and my fellow Team Water UCI graduate student researchers for teaching me how to think inter- and trans-disciplinarily.

Last but not least, thank you to the many mentors, guides, and friends, who welcomed me in to their lives during my fieldwork. I hope that I have presented your stories faithfully and with integrity.

I thank the Taylor & Francis Group for permission to include Chapter Three of my dissertation, a version of which was originally published in *Science as Culture.* Financial support was provided by the The Wenner-Gren Foundation, the UC California Studies Consortium, the UCI Center for Global Peace and Conflict Studies, Water UCI, and the UCI Department of Anthropology, with writing support from a Mellon/ACLS Dissertation Completion Fellowship from the American Council of Learned Societies. Special thanks also to the Steele/Burnand Anza-Borrego Desert Research Center, and to the Stout Research Center Laboratory and Collection Hall.

CURRICULUM VITAE

Emily Brooks
Department of Anthropology
University of California, Irvine
3151 Social Sciences Plaza A, Irvine CA 92697
ebrooks1@uci.edu
http://sites.uci.edu/ebrooks

EDUCATION

Ph.D. Anthropology — June 2017
Specialization in Anthropologies of Science, Technology, and Medicine
Advisors: Olson, V., Peterson, K., Kim, E.
University of California, Irvine

M.A. Anthropology — June 2011
University of California, Irvine

B.A. Anthropology — May 2008
Reed College

SPECIALIZATION

Area: United States, Sonoran Desert, California

Sub-Disciplines: Sociocultural Anthropology, Public/Applied Anthropology, Environmental Anthropology, Science and Technology Studies, Environmental Studies

Topics: Water, Ecological Politics, Environmental Science and Technology, Community Engaged Research, Natural Resource Management, Risk and Disasters

AWARDS, GRANTS & FELLOWSHIPS

Mellon/ACLS Dissertation Completion Fellow	2016-2017
Wenner-Gren Foundation Dissertation Fieldwork Grant	2014-2015
Water UCI/Jet Propulsion Laboratory Partnership Team Water Fellow	2014-2015
UC Humanities Research Institute California Studies Consortium Grant	2014
Center for Global Peace and Conflict Studies Fieldwork Grant	2014
Society for Applied Anthropology Spicer Award	2014
NSF Graduate Research Fellowship Program Honorable Mention	2012
Graduate Dean's Fellowship UC Irvine	2011
Phi Beta Kappa Reed College	2008
Commendation for Academic Excellence Reed College	2008

PEER-REVIEWED ARTICLES

2016. "Number Narratives: Abundance, Scarcity, and Sustainability in a California Water World." *Science as Culture* 26(1): 32-55. http://dx.doi.org/10.1080/09505431.2016.1223111

EXECUTIVE REPORTS

2016. "Drought Histories and Utopian Futures: An Analysis of California Water Epochs and Opportunities for Further Research." Report prepared for Water UCI Executive Committee.

OTHER PUBLICATIONS

2016. "Local Power: The Politics of Renewables in California." *Platypus: The CASTAC Blog.*
2015. "SOS! Save Our Sea! California's Salton Sea demands action, but what kind?" *Platypus: The CASTAC Blog.*
2014. "The Slow Disaster: Climate Change Temporalities in a Desert Town." *Anthropology News*.
2014. "'But Where are the People?': Field Notes from an Interdisciplinary Environmental Research Team." *Platypus: The CASTAC Blog.*

INVITED SPEAKER, PANELIST, & WORKSHOP PARTICIPANT

2017. Panelist, "Climate Change, Conflict, Education, and Action in the Era of Trump," UCI Newkirk Center for Science & Society. Irvine, CA.
2017. Invited Participant. "The Hydraulic Society, Revisited" Workshop, University of California, Berkeley, Berkeley, CA.
2017. Invited Student Participant. Social Science Perspectives on Climate Change Technical Workshop, US Global Change Research Program (USGCRP), Washington, DC.
2017. Guest Speaker, "The California Drought in Historical Perspective," Pasadena City College, Pasadena, CA.
2016. Invited Speaker with Simone Popperl, "Desalination Utopia: Desiccated Futures and Global Water Worlds," Whittier College, Whittier, CA.
2016. Guest Speaker, "Interdisciplinary Science Collaboration and Communication: Best Practices and Lessons Learned," UCI Climate Action Training Program Data Science Initiative Course, UCI, Irvine, CA.
2016. Invited Speaker and Panelist, "Small Water, Local Water," CleanTech Connect, Smart Utility Systems, Irvine, CA.
2015. Guest Speaker, "Why do 'Good' People Make 'Bad' Decisions?: Human Systems and Sustainability Challenges," UCI Global Sustainability Undergraduate Course, UCI, Irvine, CA.
2014. Invited Speaker, "Living in Extreme Environments: Science, Exploration, and the Human Spirit," Anza-Borrego Natural History Association Speaker Series, Borrego Springs, CA. December 2014.

CONFERENCE PRESENTATIONS

2017. Society for Applied Anthropology Annual Meeting, Speaker and Panel Co-Organizer with Alyse Bertenthal, Co-Author with Daniel Winkler, "Drought at Extremes: Connecting Biological, Socio-Economic, and Cultural Extremity in a Water Dependent Ecology," Santa Fe, NM.

2016. American Anthropological Association Annual Meeting, Speaker and Invited Session Co-Organizer with Elizabeth Hare, "Fossil Water: Modeling Sustainability in Deep Time," Minneapolis, MN.

2016. Society for Applied Anthropology Annual Meeting, "Think Small, Think Big: Local Water and the California Drought," Vancouver, Canada.

2015. American Anthropological Association Annual Meeting, "Metering from the Ground, Monitoring from Space: The Politics of Scale in California's Hidden Drought," Denver, CO.

2015. Society for Social Studies of Science Annual Meeting, "Local Power: Renewable Energy and Rural Urban Politics in the California Desert," Denver, CO.

2015. Society for Applied Anthropology Annual Meeting, Speaker and Panel Co-Organizer with Elizabeth Reddy, "Small Enough to Matter, Too Small to Care: Scaling Water Insecurity," Pittsburgh, PA.

2014. American Anthropological Association Annual Meeting, Co-Author with Simone Popperl, "Creatio ex Materia: Desalination and Sublime Water Worlds," Washington, D.C.

2014. When Nature and Numbers (Don't) Meet Symposium, "An Unimaginable Disaster: Invisible Numbers and Imagined Water in the California Desert," U Wisconsin-Madison, Madison, WI.

2014. Society for Applied Anthropology Annual Meeting, "'Planning for What?': Uncertainty and the Slow Disaster," Albuquerque, NM.

2013. American Anthropological Association Annual Meeting, "A New 'New Way of Life': Analogizing Danger in a Dying Town," Chicago, IL.

2013. Society for Social Studies of Science Annual Meeting, "Navigating Extremes: The Exploring Subject in a Material World," San Diego, CA.

2013. Feminist Infrastructures and Technocultures Symposium, "Natural Silence: Listening for Life in the Arctic," UC San Diego, San Diego, CA.

2012. Critical Geography Annual Conference, Speaker and Panel Co-Organizer with Elizabeth Reddy, "Danger and Daring: Risk Assessment and Prevention at High Altitude," UNC Chapel Hill, Chapel Hill, NC.

POSTER SESSIONS

2016. Ecological Society of America, Co-Author with Daniel Winkler, "Extremes of Borrego: Biological and Social Life in a Changing Desert Ecosystem," Ft. Lauderdale, FL.

2016. Wildflowers, Citrus, and Swimming Pools: Team Water UCI Poster Presentation and Community Reception, Co-Author with Daniel Winkler, "Extremes of Borrego: Biological and Social Life in a Changing Desert Ecosystem," Borrego Springs, CA.

2013. Anza Borrego Foundation Annual Symposium, "Humans and Other Extremophiles: Ecosystem Building in the Southern California Desert," Borrego Springs, CA.

RESEARCH POSITIONS

Water UCI 2015-2016
Graduate Research Assistant

UCI Steele/Burnand Anza-Borrego Desert Research Center 2013-2017
Stakeholder Liaison, Graduate Researcher Affiliate

Fred Hutchinson Cancer Research Center 2010-2011
Clinical Research Data Coordinator, Clinical Trials Support Office

Seattle Cancer Care Alliance 2008-2010
Clinical Research Study Assistant, University of Washington

TEACHING & MENTORING

UCI Department of Anthropology 2017
Instructor of Record
Courses Taught: Language and Culture (Summer Session)

UCI Department of Anthropology 2016-2017
Undergraduate Research Assistant Supervisor

UCI Graduate Division 2016-2017
Certified Mentor, Competitive Edge Initiative

UCI Department of Anthropology 2012-2013
Teaching Assistant
Courses Taught: Language and Culture (3 quarters); Introduction to Sociocultural Anthropology (1 quarter); Medicine, Food and Health (1 quarter)

SERVICE

Office of the Ombudsman 2015-2017
Certified Mediator, UC Irvine

Platypus: The CASTAC Blog 2014-2017
Contributing Editor

Dean's Fellowship Advisory Committee, School of Social Sciences 2013-2017
Committee Member and Grant Reviewer, UC Irvine

Trans-scripts: An Interdisciplinary Online Journal 2013-2014
Editorial Collective, UC Irvine

Department of Anthropology, Graduate Program 2013-2014
Graduate Representative, UC Irvine

PROFESSIONAL MEMBERSHIPS

American Anthropological Association
Anthropology and Environment Society
Committee for the Anthropology of Science, Technology, and Computing (CASTAC)
Society for Applied Anthropology
Society for Social Studies of Science

ABSTRACT OF THE DISSERTATION

The "Hidden Drought": Water Politics and Ecology Building in California's Low Desert

By

Emily Brooks

Doctor of Philosophy in Anthropology

University of California, Irvine, 2017

Assistant Professor Valerie Olson, Chair

This dissertation explores the regional ecological politics of water scarcity during the 2011-2017 California drought. Based on over two years of ethnographic fieldwork, I center my coordinated case study on Southern California's underserved peripheral zones: small, groundwater-dependent communities in the rural desert, which have (at most) 50 years of viable water left. My ethnography follows community activists, policy makers, water scientists, technicians, and resource managers as they work to understand, protect, and sustain their local water. By examining water socialities in a region notorious for drought, I show that our existing explanatory models of water scarcity are insufficient to understand the lived reality of contemporary water politics in the Western United States. Instead, I apprehend California water through I call "ecology building": a process incorporating scientific knowledge production, historical practices, political projects, and the changing material qualities of the environment itself. Scientific and policy experts have used the term "hidden drought" to call attention to California's rapidly decreasing groundwater. I argue that hidden drought is not just about unseen water depletion. Instead, hiddenness emerges through more complex forms of invisibility or

absence: remotely sensed water data, unseen hydrological infrastructure, deep histories, archival laws, secretive political regimes, and exclusionary policies. In so doing, I show how the problem of a perpetual lack of water shapes social and political life in a diverse cross section of communities. Here, an ad-hoc regional network of activists and water experts must navigate a constantly shifting, highly technical process involving diverse stakeholders, deep political allegiances, tangled regulatory agencies, millions of dollars of scientific research, and decades of litigation. My data draw from a broad cross-section of groundwater cases, linked by a shared environment and a shared network of water experts. My longterm engagement with the region, and the breadth of my work with water scientists, technicians, policy makers, and activists, allow me to provide analysis that cuts across normally disparate registers of water expertise, drawing together the complex community politics of water governance with the highly scaled technological politics of water monitoring and modeling.

INTRODUCTION

From 2011 to 2017, California faced perhaps the worst drought in the state's history. Cyclical droughts, extreme weather events, and massive shifts in environmental policy are not new phenomena in the American Southwest; yet, even by these normative standards, this drought represents an extreme escalation of environmental, political, and scientific stakes. By 2014, the National Drought Mitigation Center reported over half of California faced conditions of "exceptional drought," indicating "shortages of water in reservoirs, streams, and wells creating water emergencies." The "water emergency" designation was echoed in emergency reduction ordinances from the state legislature, in drought mitigation planning from state regulatory agencies, and in unprecedented groundwater sustainability mandates for local water agencies. In response, policy analysts and water scientists declared the death of "big water projects" that left Californians reliant on importing and transporting water, and called instead for a move towards small water systems and locally-defined sustainability. Meanwhile, rural communities struggled to maintain control of their local water against perceived threats from county and state regulatory authorities and thirsty urban water districts, and plan for their environmental and economic futures. Water, as Californians knew it, had finally become an unsolvable problem: the drought was too big, too impactful, and too complex to be solved by known models. But, how has California water come to be understood, operationalized, and managed as a particular kind of problem? When water experts, technicians, and activists call for new ways of living with water, or fight to preserve what is already in place, what (and whose) California are they attempting to sustain?

Frequently overlooked in this conflict is rural California's historical reliance on groundwater: the naturally occurring underground aquifers that supply over 30% of water resources, particularly in times of drought. Despite their obvious importance, these aquifers are also dangerously unmonitored and under-regulated, leading scientific and policy experts to term groundwater scarcity California's "hidden drought." In dominant narratives of drought, urban centers like Los Angeles and massive farming regions like the Central Valley stand in for California as a whole, framing the drought in terms of visible indicators like urban development booms, illegally watered lawns, and unsustainable farming practices. Similarly, ethnographic studies of fresh water worldwide have typically focused on visible water systems - rivers, lakes, and overground irrigation systems - while overlooking the increasingly vital role of "invisible" water reserves such as groundwater, buried transport systems, and recycled water. By focusing instead on the "hidden" dimensions of California groundwater, I trace how hiddenness, rather than visibility, operates as a powerful positive quality in the imagining and scaling of water problems.

In what follows, I explore the ecological politics of California water from the periphery of the state-wide drought: small communities in Southern California's groundwater-dependent, rural, Colorado Desert region, which have (at most) 50 years of viable water left. My ethnography follows community activists, policy makers, water scientists, technicians, and resource managers as they work to understand, model, protect, and sustain their local water, and with it particular imaginaries of their local way of life. By examining water socialities in a region notorious for drought, I show that our existing explanatory models of water scarcity are

insufficient to understand the lived reality of contemporary water politics in the Western United States.

I apprehend California water through what this dissertation develops as "ecology building": a process incorporating scientific knowledge production, historical practices, political projects, and the changing material qualities of the environment itself. As both a theoretical framework and a "thing in the world," ecology building allows for a focus on what water does and affords rather than what water is; on the binaries and separations that happen through and alongside environmental relations, like those between coastal and inland California, or between regions supplied by groundwater or surface water. From this perspective, I argue that the "hiddenness" of the hidden drought is not just about unseen water depletion. Instead, hiddenness emerges through more complex forms of invisibility or absence: remotely sensed water data, unseen hydrological infrastructure, deep histories, archival laws, secretive political regimes, and exclusionary policies. In so doing, I reveal how the West's rapidly escalating water problems shape social and political life in a diverse cross section of communities. Here, individual towns are geographically and politically isolated; often dependent on sole-source groundwater supplies, while surrounded by an environment in which water is always already scarce (as locals joke, "the desert is always in a drought!"). Small, rural water authorities lack the resources and jurisdiction of their urban counterparts, and are frequently left out of county- and state-level policies and planning efforts. Instead, an ad-hoc regional network of activists and water experts must navigate a constantly shifting, highly technical process involving diverse stakeholders, deep political allegiances, tangled regulatory agencies, millions of dollars of scientific research, and decades of litigation.

On Ecology Building

Histories of/and Ecology

Ecology is a concept with its own history, which runs through and alongside the environmental history of California. The basic assumption undergirding contemporary environmental science and management - that environments are systems of relationships that can be identified and studied - can be traced to the so-called "ecological turn" in environmental science, which occurred at the middle of the 20th century. The ecological turn facilitated an understanding of the environment not as nature, but as an ecology or ecosystem; one constituted by relationships between parts and wholes that change over time, and *including* changing human ideas and activities. This paradigm shift dramatically reconfigured the way we understand, model, manage, and narrate our relationship to non-human nature (and to what degree we consider that nature to be "natural"). If humans are part of the same "ecological timeline" as the environment, then they are coeval and co-constitutive. A study of water is not a study of a bounded natural object, but instead a study of water-based ecological relationships between human and non-human agents in a particular space and time.

The ecosystem concept is largely an American invention of the Post-WWII era, particularly well suited to the cultural and scientific transformations of the time (Golley 1993). Despite the veneer of mechanization and scientific precision, ecology until the mid-1960s was largely based on a disciplining of analogical thinking. Prewar ecologists in particular often took lakes as their object of study, based on the assumption that the boundaries of local water systems would be far easier to see, manipulate, and model (Golley 1993, 4). Beginning with the bounded lakes and

ponds of limnology, ecologists gradually scaled their analyses up to stream beds, watersheds, and other ecosystem objects of study at the level of landscape.

At the same time, concurrent projects in field-based environmental science advanced an understanding of the biotic world as one big community composed of many interdependent parts (Golley 1993; Merchant 2007; Mitman 1992; Worster 1994). This ecosystem-as-organism imaginary required a number of powerful scalar comparisons between very small and very large forms of life, as well as an application of systems theory where complex categories of parts and wholes appear at every scale; and, indeed, the primary intellectual legacy of the ecological turn is a spatial restructuring of the relationship between parts and wholes. However, an ecological orientation also required a significant temporal restructuring, where "history" referred more to cycles and seasonal oscillations than the linear progression of time. This restructuring began to place the human into systemic temporality within nature, but often in the particular role of steward or scientific observer.

Rachel Carson's 1962 text, *Silent Spring*, and particularly her notion of the total environment, is often considered the linchpin of the ecological turn in popular environmental science, management, and policy. Carson writes, "The central problem of our age has therefore become the contamination of man's total environment with such substances of incredible potential for harm - substances that accumulate in the tissues of plants and animals and even penetrate the germ cells to shatter or alter the very material of heredity upon which the shape of the future depends" (1994[1962], 8). In Carson's view, this problem serves an ecological turning point, which reshapes both the assumed history and potential future of human-centered ecosystems. The rise of the nuclear age, the effects of industrialization, and a nation increasingly

dependent on chemical solutions mean that the environment can no longer be thought of as an externalized place and space against which humans live their lives; instead, it has become an internalized network of material relationships that may have already begun to unravel. Humans, in other words, are fundamentally ecological subjects, not simply environmental actors.

Silent Spring represents a watershed moment in American environmental thought and writing; the zenith of a larger ecological transformation in the way theorists, activists, and a growing cadre of physical and social scientists understood, scaled, and analyzed the relationship between humans and the environment. By characterizing this shift from nature to total environment, Carson also issues a powerful call for analyzing the environment as a function of relationships between human and non-human agents across space and time. As methodology, the total environment draws attention to cumulative effects on a biotic community, slow change over time, and the unforeseeable impact of the past on the future. As theoretical framework, it reveals that the human is no longer outside of or impervious to ecological flows across space and time, and questions the future potentiality of life (all life) itself.

Ecology Building

As an analytical framework, ecology building emerges from and engages with this history of ecosystem ecology, as well as methods and analytical frameworks from environmental anthropology, science and technology studies, and environmental history. As I deploy it within an ethnographic context, ecology building becomes a lens for reading the relations between scientific knowledge production, historical practices, political projects, and the changing material qualities of the environment itself across space and time.

My use of "ecology" as a concept for organizing relations between people, places and things, and for categorizing and dividing environmental modes of analysis, derives from the work of anthropologist Tim Choy. Ecology is both epistemological, "a branch of the life sciences concerned with organisms and their interactions with their environs" (2011, 11), and ontological, "an emergent web of relationships among constitutive and constituting parts" (2011, 11). In this sense, an ecological analysis involves attending to how situated specificities interact with each other ecologically; that is, through emergent relations between things that are not commensurable. I follow Choy in seeking to demonstrate that ecological relations do not presuppose spatial or temporal scale, but enact it: "Knowledge practices constituting environmental politics rely upon and generate scales of comparative analysis - local, global, specific, general, particular, universal, species, ecosystem - in the course of drawing ecological comparisons and relations" (2011, 12). As I show in later chapters, for example, grassroots water advocacy is not a simple matter of scaling problems and solutions up and down, from the local to the global, but rather of ad-hoc work at the scale that is most meaningful to engage a particular dimension of the problem. This holds for temporality as well. While this definition of ecology might seem to suggest a synchronic approach on the model of cultural ecology or ecosystem ecology, it instead proposes something slightly different: that explicitly temporal modes of attention like nostalgia for an imagined past, iterative planning for a renewable and sustainable present, or predictions for a dried-up future have a particular time-space that emerges through their enactment.

Ecology building also recognizes the critical relationship between the past, the present, and the imagined future, as seen through the co-production of nature, culture, science, and

technology over time and space. As such, I orient to California as what Sara Pritchard terms an "envirotechnical landscape," which changes over time as it is remade by competing, overlapping "envirotechnical regimes." These regimes - "the institutions, people, ideologies, technologies, and landscapes that together define, justify, build, and maintain a particular envirotechnical system as normative" (2011, 23) - define a view of technology as including nature, material infrastructure, engineering logics, and social and political forces. The problem of managing water can shape the scope and scale of a given region, state, or nation's political, economic, and technoscientific governance, particularly in cases of water conflict. Social and political processes like nation building and regional boundary making take up ecological objects like rivers in their material enactments, and histories of water as an environmental objects can uncover social histories as well. From this perspective, I show how Southern California's water world - like other social worlds, political regimes, and indeed entire nations - is not separate from water, but rather is built in and through engagements *with* water.

This is, perhaps, uniquely true with regard to California, a state notoriously defined not only by water, but by water conflict; the attempt to delocalize and then relocalize water in order to make given spaces inhabitable, productive, and aesthetically pleasing. To highlight the ways in which California water has and continues to mobilize particular forms of labor and power for its enactment, I draw on California historian Donald Worster's hydraulic society thesis, the idea that "the domination of nature is an ambition that first appears stark and unchecked in the archaic desert empires, and thereafter the ambition, wherever and whenever it recurs as a compelling cultural idea, is always associated with the domination of some people by other people" (1982, 506). Worster pinpoints the midcentury era (specifically calling out the large-scale infrastructural

work of the Bureau of Reclamation - dams, reservoirs, canals, pipelines, tunnels, pumping plants, and power plants) as that which completely, and perhaps irrevocably, remade the western river landscape in accordance with demands for large-scale irrigation and production for profit rather than use, remaking its attendant political, economic, and cultural forms along with it. Hydraulic society then constitutes a mode of production, which transforms both social relations and the makeup of nature itself.[1] While some aspects of the hydraulic society thesis have been rendered less applicable in recent years - Worster's emphasis on big infrastructure and centralized state control, for example, cannot adequately capture the contemporary dynamics of so-called "small water systems" or groundwater - I take from it an emphasis on the work of ecology building, and the complex, multi-scalar practices of exclusion and disenfranchisement that this work can engender.

As theory, ecology building speaks both to existing work on water and ecology specifically, as well as to a broader body of anthropological and science and technology studies work on environmental science, technology, and politics. It acknowledges that practices of knowing the world are never separable from realities of being in the world (Bennett 2010; Ingold 2000; Raffles 2002); as Barad reminds us, "We are a part of that nature that we seek to understand" (2007, 26). It responds also to the complex problems of scale in ethnographic approaches to objects of study like climate change and the anthropocene (Crate and Nuttall 2009; Latour 2014; Sayre 2012). The scale of these hyperobjects - "massively distributed in time and space relative to humans" (Morton 2013, 2) - stretches the boundaries of the anthropological object of study (albeit while keeping the human at the center), and threatens to collapse the

[1] Although Worster is not often cited in environmental anthropology, he credits the phrase "hydraulic society" to "two students of ancient cultures, Julian Steward and Karl Wittfogel" (1982, 506)

uneven spaces of difference that shape how people actually experience the changing environment in their daily lives. Ecology building is a "small" theory for partial connections (Strathern 2004); an embodied perspective on particular engagements with specific qualities of the environment, some of which remain extremely localized forms of understanding, and others which shape entire cosmologies. As such, it offers a way in to something like the California drought or Western water scarcity, without collapsing the specificity of difference across human experiences of drought "in the field," and without diminishing the very real ethical concerns that arise when communities must live with the products of expert knowledge practices and the consequences of unevenly distributed environmental insecurity.

Research Design

Based on over 2 years of ethnographic fieldwork and archival research in the Southern California desert region between 2013 and 2016, my data draw from a broad cross-section of groundwater cases, linked by a shared environment and a shared network of water experts. Taken together, these data represent the "lifetime" of a water problem in the low desert, allowing my analysis to speak from an ecosystem-level perspective. My longterm engagement with the region, and the breadth of my work with water scientists, technicians, policy makers, community leaders, and activists, allow me to provide analysis that cuts across normally disparate registers of water expertise, drawing together the complex community politics of water governance with the highly scaled technological politics of water monitoring and modeling.

Using the lens of ecology building, I investigate water as a cultural, political, natural, and scientific phenomenon by examining the relationships between explanatory models, markers of

scale and significance, and ecological stakes of water problems. My data collection was guided by the following research questions:

1. How do activists, local experts, public officials, water scientists, and technicians develop explanatory models (cultural, natural, scientific) to understand and explain local water, ecological change over time, and the presence (or absence) of water problems?
2. How do these explanatory models draw on perceptions of the spatial and temporal scale of ecological problems?
3. Given these explanatory models, how do these individuals and groups determine which actors count as having a stake in or being significant to the unfolding of water problems? How are these stakes or significance scaled? What kinds of decisions, actions, plans, and other forms of ecology building result from these understandings of ecological stakes and significance?

A study of groundwater is perhaps necessarily a study of the local: groundwater's material properties, and its history of being managed in situ, led me to a deeply community-driven, place-based approach, attentive to how local and regional scales emerge and are made to matter (in both senses of the term) in broader discussions of California water. Over the course of my fieldwork, I continually iterated the scope and scale of my project accordingly. Through my preliminary research, I initially designed a case study based on a single community - which I refer to pseudonymously as Smoketree Springs - and their struggle to understand, model, and manage their groundwater. As I continued exploring the field, however, two events caused me to broaden my field of inquiry. First, the emergency drought declaration and increased attention to statewide groundwater management brought my field site into even more complex and specific

relations with regional, state, and national scales of governance and scientific knowledge production. Second, my work with local experts in Smoketree began to surface the broader network of advocates, technicians, scientists, public officials, and seasonal residents that move between communities in the low desert region, and between the desert and the coast, brought together through their participation in various forms of water sociality.

Capturing the particular extremes, ebbs, and flows of desert life and desert water would thus entail broadening my operationalization of what counts as "local." My eventual constellation of field sites included six small communities with specific water cases in eastern San Diego County, Imperial County, and Inyo County, as well as the sparsely populated desert regions between and around them, and the broader network of consulting scientists, policy makers, activists, and practitioners connected to them from elsewhere in California, such as Orange County, San Diego, Riverside, and Sacramento. Rather than delineating a set period of time to spend in each community before moving on to the next, I replicated the experience of my interlocutors by continually traveling between them, responding to different communities and waters as events dictated. In so doing, I, like my interlocutors, experienced the desert not as an external force on or backdrop to the social, but as a constant, vibrant presence shaping its rhythms.

Ethnographically, this work is designed to contribute to critical studies of environment and sustainability by bridging environmental anthropology and science and technology studies in an archetypal U.S. context. I continue the work of previous scholarship on the intersection of environment, expertise, and governance by addressing the cultural politics of knowledge flows and technoscientific systems (Pritchard 2011); attending to matters of scale in community

responses to regional, national, and global politics (Tsing 2005; Choy 2011); and tracing how multi-scalar practices of exclusion across political, social, and technological registers shape the production of ecological subjects (Fortun 2001). I build on this scholarship by locating my ethnography in Southern California, a region notorious for water wars, environmental instability, and unsustainability. This project's geographical focus reflects the centrality of the United States in the development of ecological science and environmental history (Cronon 1983; Golley 1993), and the significance of California as a case study in modern ecology building (Merchant 1993; Nash 2006).

There is significant historical scholarship on water management in the Southwestern United States in general (Reisner 1993), and on California's "hydraulic society" in particular (Erie 2006; Hundley 2001; Merchant 1998; Worster 1982), documenting the formation of the legal and political complexities that shape water management today. Despite this interest, few ethnographic studies of water have been conducted in this region, and these studies have tended to focus on water politics, policy, and governance (Espeland 1998). By also maintaining a critical focus on science and technology, I show how both water policy and water technology are underwritten by powerful cultural values and ethics (Carroll 2012; Jasanoff 2006), and challenge public assumptions that cultural concerns are irrelevant to the implementation of science-driven water policy in the United States.

Theoretically, this study responds to growing social scientific interest in slow ecological disasters like drought, desertification, and climate change, which exceed both everyday perception and conventional problem-solving timeframes like careers and lifetimes. As an object of study, water resists easy theoretical abstraction as a commodity, a human right, or a neutral

object of scientific inquiry (Bakker 2012; Ballestero 2015; Barnes and Alatout 2012; Orlove 2010). By attending to water as an object of technological (as well as social and political) concern in the context of a drought, this project merges scholarship on water as a nexus of political control and environmental justice (Espeland 1998) with critical studies of water expertise and water socialities (Orlove 2002; Helmreich 2009), and scholarship on perceptions of environments and temporality (Ingold 2000; Raffles 2002). Through my focus on the hidden dimensions of California water as a cultural construction, I also add complexity to theoretical perspectives that assume fresh water is either visible or invisible, abundant or scarce. Hiddenness instead shifts attention to the epistemological and material processes by which abundance, scarcity, or sustainability come into being.

Southern California provides a valuable case study in water wars and drought that is both distinctive and representative of global trends. Slow ecological disasters present new challenges, while also operating in more subtle ways as "threat multipliers" (Crate and Nuttall 2009). Here, as elsewhere, the threat of water scarcity amplified existing political and economic disparities between residents; revealed the crumbling state of existing infrastructure and outdated water rights systems; called attention to under-regulated water resources; and re-energized old debates over conservation, environmental health, and the uneasy relationships between urban and rural places. While the environmental, cultural, and economic consequences of environmental disasters in general (and drought in particular) have received considerable attention worldwide, qualitative social scientists have only recently become significant participants in a conversation largely dominated by experts in environmental science, policy, and economics. With this dissertation, I offer a much-needed anthropological perspective, relocating water within its

human landscape, and grounding large-scale, long-term discussions of water sustainability in the everyday lives of those living with a changing water world (Hastrup and Rubow 2014).

Chapter Outline

The chapters that follow each highlight a key concept around which practices of ecology building crystallized. In keeping with my orientation to these communities as a region, I move between scales and communities within each chapter, rather than treating them as separate case studies. In between the Chapters, I include vignettes following the "seasonal round" (Hufford 2016) of life in the low desert, the seasonal activities and practices driven by fluctuations in weather and climate that make up locals' daily lives. Given the sensitive nature of both water problems and small town settings, I have chosen to alter certain identifying details to protect my interlocutors' privacy and confidentiality. With the exception of Chapter One, I use pseudonyms for communities, organizations, and people, except for high profile public figures (such as state government officials and prominent university researchers) and certain individuals who have requested, as part of their own personal political practice, that I refer to them by their real names.

Chapter One, History, begins from ethnographic moments where California's complex water history emerged as a problem for contemporary water management, such as the argument that the 2011-2017 drought constituted a final "tipping point" in how residents understood water. Here, I characterize California's water history as a series of intensely place-based epistemic shifts in how water is characterized, specific to the social, political, economic, and environmental dynamics of the time. As California's watery history comes under new scrutiny, this uneven

historical terrain continues to enliven and animate the ways that people today understand California's past, unstable present, and potential future.

Chapters Two and Three present two ways of understanding and managing groundwater from the perspective of communities that live with it: Fossil Water, and Number Narratives. In Chapter Two, Fossil Water, I draw on interviews with geologists, citizen scientists, and activists in three communities to examine practices of understanding and modeling groundwater as non-renewable (and potentially non-sustainable) "fossil water." At stake in these conceptual models, I argue, is whether all water on earth is part of a renewable ecological cycle, or whether ancient groundwater aquifers must instead be studied, modeled, and managed on a different, more geological timescale. In Chapter Three, Number Narratives, I explore hiddenness through the concept of number narratives in rendering groundwater problems. This chapter zooms in on one town's struggle to establish technical and policy numbers that "speak" to their localized water problem, while illustrating how these formalizing practices make water visible and thinkable in terms of abundance, scarcity, or sustainability.

In Chapter Four, Emplaced Advocacy, I delve in to the messy world of water advocacy, highlighting both formal public engagement processes and informal, day-to-day challenges of governance in four different communities. Here, I follow volunteer and para-professional activists as they navigate the complex rules and regulations governing California water management, and build forms of advocacy that are deeply emplaced; situated both politically and ecologically. I analyze how these disparate stakeholders are brought together through their shared water advocacy, and how they determine who (or what) is hidden from or left out of the process, and denied ecobiopolitical subjecthood.

In closing, the Conclusion reflects on the "end" of the 2011-2017 drought, and examines the emergent political ecology of groundwater scarcity, extreme drought, and water emergency in California from the perspective of small communities, regional and state practitioners, and big data scientists. Who "speaks for" water problems like drought and groundwater scarcity - for their causes and potential long-term impacts - how, and at what scale?

CHAPTER 1: HISTORY

Introduction

In early July of 2014, a few hundred government hydrologists and assorted water managers from across the Western United States converged at the Nugget Casino Resort in Sparks, Nevada for the American Water Resources Association's regional conference. This summer, the conference theme was best practices for "integrated water resource management," a process designed to consolidate overly complicated and redundant water practices according to regional watershed boundaries, thus increasing sustainability, efficiency, and resilience for the water system as a whole. The stakes of these efforts to remake how the West lives with its water were clear from the start; earlier that week, the United States Drought Monitor had reported that over half of California now faced "exceptional drought" conditions. As became clear to me during the conference, everyone in the water world was watching to see how (or whether) California, a place synonymous with deeply entrenched and overly complex water management systems, could adapt its outdated water practices to the scope and scale of contemporary water problems.

I was told that attendance is rarely high for the early morning keynote presentations that begin each day of the conference, but the room is packed for Gary Bardini, Deputy Director for Integrated Water Management for California's Department of Water Resources (DWR). He intends to talk about implementing California's new Integrated Regional Water Management (IRWM) project, but ends up spending most of the Q&A time fielding questions about DWR's take on cascading drought impacts and potential regulatory responses. Eventually, and by way of closing, he shrugs, "In California, we move water from places that have it to places that don't

have it. It's who we are; it's what we do; it's what we've always done. It'll be interesting to see what happens when, all of the sudden, we have to make that same water stay in one place."

Over the course of my fieldwork, I sat in many rooms like this, watching experts of all kinds grapple with what they called a new era in Western water management. By the time the current drought "began" in 2011, it seemed no longer possible (if indeed it ever had been) to think of California water as a system that was too big to fail, seamlessly moving all kinds of water from place to place, insulated from the effects of the state's arid and semi-arid climate. Instead, as the state endured the worst drought on record, and the third such drought in the past 40 years, this large-scale narrative suggested that Californians found themselves at a threshold moment.

California's cultural and ecological past is defined by technological interventions designed to manipulate "natural" water patterns and flows; to move water quickly and efficiently based on particular human needs and according to human labor and capital. California *is* its watery past, the penultimate example of Donald Worster's hydraulic society as mode of production thesis (1982). It's no surprise, then, that contemporary cultural politics around water are frequently bogged down by the past; notoriously overdetermined by laws and rights systems established in the 19th and early 20th centuries, and nearly impenetrable to those not versed in highly technical, locally-specific knowledge practices. Nor is this simply a problem for high level water managers like Bardini. As I often experienced during fieldwork, would-be participants in local or regional water politics are commonly subject to gatekeeping practices that force them to prove they are sufficiently knowledgeable of (and experienced with) local history, water issues, and technical jargon. While some interlocutors viewed these hurdles as necessary burdens of becoming an

effective stakeholder, others suggested they worked within existing hierarchies of power to filter out undesirable or dissenting opinions on the future of their communities.

In this chapter, I use these ethnographic moments - where the past becomes a boundary, a hurdle, or a scapegoat for contemporary water problems - as a jumping off point for engaging the discursive history of California water. On one hand, this is hardly an understudied topic. While Norris Hundley Jr.'s 800-page tome, *The Great Thirst: Californians and Water: A History*, is widely considered to be the standard, dozens of exhaustively researched histories cover similar scholarly ground. On the other hand, it is precisely this overdetermination of what "counts" as California's water history (and what remains obscured, understudied, or hidden) that I seek, in part, to explore. As a mode of attention for reading history, ecology building shifts attention from the environment as a relatively static object outside of and separable from human activity, and towards the relations between environmental objects and specific institutions, practices, and formations over time. As I deploy it in this chapter, ecology building also calls attention to how certain people (from individual water barons to groups like desert farmers), institutions (the rise of the irrigation district and the specter of the Metropolitan Water District), places (insatiable Los Angeles and the overlooked Salton Sea), and things (major infrastructure like canals and dams) come to stand for California water as a whole, to the exclusion of other individuals, groups, and practices.

As California's watery history comes under new scrutiny, this uneven historical terrain continues to enliven and animate the ways that people today understand California's past, unstable present, and potential future. In this sense, this chapter stands as both historical background to the ones that follow, and exercise in reading the relationship between history and

ethnography. In this and subsequent chapters, hiddenness emerges ethnographically in the genre of history, as water itself becomes an archive[2], and as would-be participants in water politics find themselves forced to engage with the complex and deeply entangled local histories of communities, agencies, and other forms of governance. Likewise, how that history is curated, narrated, and re-activated at different times and by different people is fundamentally about which humans (and other-than-human living and non-living beings) are recognized as ecobiopolitical subjects (Olson 2010), but also who is able to write themselves in to the background of the story through secrecy and obfuscation.

Outline

This chapter is divided into two sections. In the first, I draw on debates within environmental history to apply ecology building as an analytical framework for California water history. In the second section, I deploy this analytical framework to characterize California's water history as a series of intensely place-based epistemic shifts in how water is characterized, specific to the social, political, economic, and environmental dynamics of the time. By comparing these specific, situated envirotechnical regimes, I show how the multiple ontologies of California water are enacted in practice, how particular ways of controlling and managing water as a resource are naturalized within the telling of history, and how water scarcity becomes a problem that is both specific to a particular time and place, and representative of broader shifts within California's social, political, economic, and environmental history.

[2] The idea of water as archive and material trace is covered in greater detail in Chapter Two.

Histories of/and Environment

As ecosystem ecology began to shape how environmental scientists and activists organized the world around them, the nascent field of environmental history took a longer view of relations between humans and their environment, struggling to both capture and scrutinize assumptions built in to the management of the natural world according to human needs. Methodological debates of the time reveal not only the intellectual trajectory of the field, but also scholarly reactions to the role of history in popular debates over land and water in California and elsewhere.

Nash's *Wilderness and the American Mind* (1967), an intellectual history of the cultural and philosophical evolution of the American concept of wilderness (here meaning nature and natural), is widely considered to be the first true environmental history. Beginning with the settlement of the New World, Nash demonstrates how wilderness has been a useful resource contributing to one's survival, a useless space that must be tamed, a romanticized "wild" counterpart to cities completely under human control, a source of elevated American pride in response to Old World sensibilities, and a place that must be preserved, protected, and managed. Describing the early development of environmental history that followed in the wake of *Wilderness and the American Mind*, Donald Worster writes, "This new history rejects the common assumption that human experience has been exempt from natural constraints, that people are a separate and uniquely special species, that the ecological consequences of our past deeds can be ignored" (1993, 3). Here, nature is defined in terms of understanding particular landscapes that are transformed in to natural resources through technology, industrialization, and capitalism, as well as knowledge practices like scientific research. It's interesting to note that

technology occupies a tenuous position on the nature/culture divide here as both source and object of study. This "technological environment," Worster writes, is studied "in the very specific sense that technology is a product of human culture as conditioned by the nonhuman environment. But with such phenomena as the desert and water cycle, we encounter autonomous, independent energies that do not derive from the drives and intentions of any culture" (1990, 1089).

In Worster's perspective, then, evidence of the human destruction of the environment means we can no longer entertain the naive perspective that we *and our history* are not part of the environment (1990). Accordingly, he describes three levels of analysis for the agenda of environmental history: historical, based on the structure and distribution of natural environments of the past and drawing on scientific sources; modes of production, based on the intermixing of tools, work, and social relations; and perceptions, ideologies, and ethics, based on people constructing cognitive maps of the world around them (1984, 1990). Modes of production is the most crucial frame of analysis for Worster because it focuses attention on the interaction of tools and technology with the environment itself, highlighting that these modes organize and transform not only human social relations, but also nature. In that process of transforming the earth, people have also restructured themselves and their social relations.[3] Environmental history then attempts to determine in which direction the lines of causation run; from nature to technology to belief, as in a materialist determinist perspective, or from belief to technology to nature, as in a social constructionist or idealist determinist perspective.

---

[3] Highlighting the impact of capitalism in this way allows for analyses of agriculture and general markets in land, as well as expanding the focus of the classical Marxist definition of modes of production beyond the restructuring of human relations, the buying of labor as a commodity, and the organizing of labor to produce more commodities (Worster 1993, 8)

Building on Worster's argument, William Cronon suggests that what is needed is a social environmental history that also accounts for race, class, gender, and transformations in modes of reproduction over time, and for this reason, environmental history should focus its attention on the transformation of particular regions. Thus, environmental historians begin from the assumption that nature exists only in a particular time and space, and that "the particulars of historical environmental change are no less important than the timeless abstractions of ecological processes" (1990, 1122). Reflecting on the over-emphasis on modes of production and materialism within early scholarship, Cronon instead attempts to reorient the field towards a greater appreciation of cultural constructs, writing, "We have either had studies of ecology and economy, or studies of ideas of nature; too rarely have we had the three together" (1990, 1123). Toward this end, Cronon suggests environmental history should begin by approaching the set of relationships that shape social and environmental difference in a given place, and particularly the relation of difference to power (1993, 14). Cronon's body of work, most notably *Changes in the Land: Indians, Colonists, and the Ecology of New England* (1983), emphasizes the degree to which nature should be understood as always already manipulated. There is no nature "before" humans, either conceptually or chronologically, and every nature is already a human-nature hybrid. Cronon's use of historical materialism also pushed Marx's idea of a resource in to a more perceptual realm. Drawing on Maurice Godelier, he explains that "a natural 'resource' cannot exist without some intervening human agency that defines it" (1983). In other words, a resource is what a given community recognizes as a resource; there are no resources as such, but only possibilities for resources presented by a society at a given moment in its evolution.

California Ecologies

Historian Donald Worster writes, "No region on earth has had more to do with shaping the twentieth century than California. That is as true of agricultural history as it is of mass culture, sexuality, urbanization, atomic bombs, and the shift from bourbon to wine" (1982, 503). California becomes emblematic of transformations across American environmental science, management, and governance during the 20th and 21st centuries, as well as a paradigmatic case study for an environmental history of water, land, and territory. As Ruth Gilmore explains, the importance of California as a case study is not that it represents a convenient average of the United States as a whole, but rather that "the State stands in as a plausible future for polities within and outside national borders" (Gilmore 1998/99). That is to say, California's history and present stand in for the history and present of both the local and the global, politically, economically, and ecologically. Ecological change is consonant with particular kinds of territory making, and the remaking of Californian land and ecosystems shapes and is shaped by transformations in policy, industry, and social movements (Gilmore 1998/99; Merchant 1998; Nash 2006).

As an ecological region, California is both incredibly specific and incredibly diverse: a patchwork quilt of radically different bioregions, including coastal lowlands, high alpine mountains, marshy valleys, and at least two distinct deserts (the Mojave and the Colorado). These differences in geography and geology shape differences in culture as well: the lush and largely urban coastal cities are loosely separated by the Peninsular Mountain Range from their environmental, social, economic, and political Others in the agricultural centers of the Central Valley, and the rural settlements of the Great Basin and desert regions. While water is frequently

considered the primary environmental issue for California, it's impossible to think water in isolation from other issues about land, landscape, disenfranchisement and territorialization. To this end, the environmental history of California is frequently written as the transformation of California's natural landscape in a series of movements, from Native land use and ecological cosmologies (Heizer 1998), to Native encounters with Spanish colonization (Hurtado 1998), to the forced incorporation of Native and Spanish lands that shaped the early dimensions of California's continued history of boundaries drawn and disputed by immigration, disenfranchisement, and territory making (Merchant 1998). Ranching, agriculture, and mining drove the dramatic, large-scale appropriation, extraction, and processing of the land as natural resource (Kelley 1959; Dasmann 1994), and inspired later efforts to preserve and restore nature to its "pre-human" (more accurately, pre-ranching or pre-colonial) state (Rakestraw 1972; Reisner 1986). In this sense, California is a prime example of the entangled history of humans remaking and being remade by land; of transformative ecology building in practice.

California's Water History

There are many ways to tell the history of water in California, tracking patterns of change in water infrastructure or policy, or shifts in water availability. Water practices, decisions, and policies are dynamic, changing according to political, economic, environmental, and social shifts. Yet, there are also constants; as Gottlieb and FitzSimmons write, "Water politics in Southern California have always been politics of growth…finding strategies to subsidize an increased and reallocated supply of a necessary natural resource so that, no mater how rainfall might fluctuate from year to year, economic growth would anticipate no checks and no

limits" (1991, xvi). In Southern California's Colorado Desert, this is also the story of a place deeply shaped by practices of settler colonialism (Cattelino 2011), from the forced removal of indigenous peoples (and the subsequent objectification and ossification of indigenous culture as part of the region's natural history); to settlements based on large-scale practices of "greening" the desert for both agricultural production and Sunbelt leisure culture (enacting racialized narratives of prosperity and progress through the landscape itself, as well as the bodies of its inhabitants); to the economization and extraction of natural resources like water and minerals from the earth; to the militarization of desert "wastelands" beginning in World War II, further concretized through the disposal of military waste and the constant specter of nuclear ruin (Kuletz 1998; Masco 2006); to contemporary efforts to evacuate the desert of living beings and impose population-scale logics of development and sacrifice zones for large-scale renewable energy projects.[4]

Resource Boom and Conservation Debates

The contentious relationship between mining and agriculture structured much of California's envirotechnical regime in the 19th and 20th centuries, with water (and not land) eventually emerging as the central natural object of concern (Merchant 1998). These relationships of geography and geology - the mineral-rich mountains above temperate valleys - become political and economic topographies as well, as the mining and agricultural industries battled for control over shared resources that resisted human attempts at control. By the mid-1800s, Central Valley hydraulic mines and farms were engaged in state-level battles (via the

[4] The politics of sacrifice and sacrifice zones will be dealt with in greater detail in Chapter Four.

Committees on Mines and Mining and Agriculture, respectively) over which resource-based industry was more valuable for California's productivity and pride (Kelley 1959). These old boundaries have only solidified over time, shaping property holdings and water management conflicts that still continue to the present day.

In Southern California, this moment saw the inception of Los Angeles as a "hydropolis" (Starr 1990), and the expansion of irrigated agriculture as the means to economic development, as well as social and spiritual progress (Kahrl 1982). Hanak et al, refer to this time period as the "Laissez-Faire Era," encompassing events like the Gold Rush, "land boom," and large-scale irrigation and agricultural development that took place during and after the 1880s, and emphasizing the lack of formal regional or state-level coordination of water activities (2011). In some areas, farmers pooled private resources to protect and develop their water investments. In 1887, the Wright Act (which authorized the formation of irrigation districts to support water development and distribution) began to shape the system of highly decentralized local water management that continues to this day (Hanak et al 2011, 30). By the turn of the century, "a tight-knit community of development interests - the 'water industry' - had set up an institutional framework that removed subsequent water issues from public view" (Gottlieb and FitzSimmons 1991, 105). At the same time, and following Worster's and Cronon's reminders that conquest and control of "nature" is also conquest and control of racialized others, these massive land use projects were made possible by and through the genocide of California Indians, with the violence sparked by the Gold Rush stoked by government officials eager for a blank slate on which to impose their own vision for the land (Madley 2016).

In the late 19th century and early 20th century, California became the central battle ground for the first wave of the conservation movement, and its internal schism over nature as economic resource or nature as aesthetic and spiritual resource. Although the conservation movement represented a shift away from the previous era's relentless exploitation of nature, it's important to note that the separation of humans (or, more accurately, the separation of certain kinds of humans enrolled in California's envirotechnical regime) from nature persisted; either way, land and water were to be carefully managed for human use. During the Progressive Era, concerns over resource depletion began to emerge, manifesting in attempts to "reclaim" land damaged by irrigation or logging, and culminating in The Reclamation Act of 1902 and the widespread promotion of conservation in response to increasing industrialization (Reisner 1986; Strong 1988). With John Muir's Yosemite at the center of many of these conflicts, California's natural landscape came to stand in for an entire nation's concept of the unique qualities of American wilderness. It's interesting to note here that this thread of California's environmental history is largely a story of Northern California. While the Southern Desert (now called the Sonoran Desert) did occupy an important symbolic place for many conservationists (Hogue 2000; Leopold 1966), its preservation in California did not galvanize public support on the same national scale, perhaps because the desert was markedly less amenable to the kinds of resource intensive development that flourished in the mountains and coastal valleys.

Schisms within the burgeoning conservation movement drove many of the Progressive Era controversies over the protection of natural resources in the West, most notably the case of the Hetch Hetchy Valley in the Yosemite Wilderness of Northern California. Here, the controversial 1908 proposal to dam the Tuolumne River at the Valley to create a reservoir that would supply

the San Francisco Bay Area brought the issue to a head: which action would serve the greater needs of future generations, preserving a natural landmark or safeguarding water resources for a growing metropolis? (Nash 2001). By the time the 1913 Raker Act permitted the flooding and damming of the Tuolumne, Hetch Hetchy had become the catalyst for nationwide concern over environmental protections. It's interesting (if not particularly surprising) to note that this charismatic case centered on the material and symbolic properties of water; its ability to be moved or contained, its value as property or as spiritual resource; its status as both natural and technological; and its ability to sustain the health and vitality of both humans and environments. In short, the case of Hetch Hetchy signals how water as an environmental object would come to define and be defined by subsequent transformations in environmental science and cultural politics.

Big Water Projects

During the first few decades of the 20th Century, California saw rapid population growth, a shift in the economy towards agricultural production, and new demands for water supplies and flood control that created a need for massive infrastructural projects capable of moving and managing water over much larger distances, all characteristic of the so-called era of "big water projects" (Hanak et al 2011; Hundley 2009). Major institutions of the modern water industry - the Metropolitan Water District (MWD), the Los Angeles Department of Water and Power (DWP), and the Imperial Irrigation District (IID) - took shape during this epoch. At their height, local water agencies "designed billion-dollar public-works projects, structured policies that would affect millions of people and bring millions of acres under irrigation, and enlisted federal,

state, and local politicians and bureaucrats to support these efforts" (Gottlieb and FitzSimmons 1991:4).

At the same time, decentralization and and an emphasis on local or regional interests continued to dominate the water landscape. For example, as irrigation districts continued to form through the boom years of 1915-1920, California's farming industry underwent a profound shift in professionalization, with agricultural interests consolidating unprecedented resources and power in their local areas (Henley 1957; Worster 1982). At the regional level, the signing of the Colorado River Compact in 1922 is a paradigmatic example of Western states' efforts to maintain state-level control of their water, rather than ceding control to federal interests in Washington (Hundley 2009).

In Southern California, the building of modern Los Angeles was spearheaded by powerful figures like William Mulholland, Chief Engineer for the Los Angeles Bureau of Water Works and Supply (later the Los Angeles DWP), and Frank E. Weymouth, Chief Engineer of the MWD, and by major projects like the Los Angeles Aqueduct (completed in 1913) and the Colorado River Aqueduct (completed in 1935) (Davis 1994; Hundley 2009; Mulholland 2000; Ostrum 1953). The story of the Owens Valley conflict, in particular, looms large as a charismatic casualty of Los Angeles' relentless growth agenda during the early 20th Century (Davis 1994; Mulholland 2000), and, more broadly, of Southern California's ongoing (and potentially zero-sum) conflict between urban and rural water interests; Los Angeles gained a reputation for "looting" land and water from distant communities, and "another Owens Valley" became shorthand for "the desiccation of an agricultural region for the sake of urban development" (Walton 1992, xviii).

South of Los Angeles, in San Diego, a rapidly growing urban population began to strain the reservoir and dam system. By the 1920s, planners noted that the city's previous reserve supply baseline of seven years had now dwindled to less than four, thanks to a population that exceeded their expectations (Walker 2004, 24). Across the mountains to the east, IID, the largest of the irrigation districts, was formed in the Imperial Valley in 1911 when voters elected to form a public agency to acquire the irrigation works of the California Development Corporation[5] (Worster 1982). The Imperial Valley quickly became dominated by a powerful landowner class, and shaped by Biblical metaphors of making the desert bloom (Starr 1990).

Mid-Century Growth and Expansion

The mid-century period spanning from 1930 to 1970 is one defined by growth and expansion: of urban populations, of irrigated agriculture, of land development, and of water agency power and resources. Worster's hydraulic society reached its peak, as functionally limitless water became symbolically linked to continual growth and political and economic prosperity. In 1960, water analyst Harding was inspired to write, "California has been a pioneer and a leader in nearly all forms of the use of water" (xi), representing the dominant attitude of the time that Californians had conquered nature on their own and for their own needs. Based on Harding's analysis of supply and demand projections at the time, supply so substantially exceeded demand that, for the next 100 years, "California can meet all of its future demands for the use of water" (Harding 1960, 31).

---

[5] The same organization that had, just a few years earlier, been responsible for the accidental formation of the Salton Sea when the Colorado River overflowed the CDC's massive irrigation project to green the desert floor.

By World War II, many of the recently built local water infrastructure projects were already beyond the capacity of their local areas (Harding 1960, 164-165). Shortly thereafter, California rose to national prominence for its agricultural industry and its growing population, becoming the most populous state in the nation after 1963. "At the heart of these changes," writes Hundley, "was an aggressive policy of seeking water on an even grander scale than before" (2009, 204).

This transformation was expressed through massive infrastructural projects like the Hoover Dam (then Boulder Canyon Dam), the Central Valley Water Project, and the State Water Project, and through technical products like the 1957 California Water Plan prepared by the Department of Water Resources (DWR), which, its authors claimed, for the first time gave Californians "an in-depth, realistic picture of the state's water needs and resources" (Harding 1960, 55). At the same time, and reflecting Harding's quoted statement above, perceptions of plentiful water availability drove an intensive growth agenda for land use, particularly in Southern California, and shaped the "classical era" of water resource economics (Griffin 2012; Gumprecht 2005).

In Los Angeles, the availability of Colorado River water beginning in the 1940s further accelerated the pace of growth and development. The city's relentless expansion during this time is often pathologized in historical accounts: Hundley writes that the Colorado River had a "profound psychological effect on city leaders and planners. It obliterated any sense of restraint about Los Angeles' capacity to absorb ever more people and industries" (Hundley 1992; 231). However, Los Angeles' power and reach expanded unevenly, and in ways that challenge the outsider's view of a homogenous urban behemoth. Between 1950 and 1954, seven new member agencies serving agricultural areas joined MWD, diluting the power of the urban center (Gottlieb and FitzSimmons 1991), and splitting MWD's interests within its service area. In subsequent

decades, as MWD sought to better consolidate its power and resources, the agency entered in to state and national policy arenas. MWD then came to stand in for all of Southern California nationwide, and the region became synonymous with unchecked growth bolstered by unlimited water (Gottlieb and FitzSimmons 1991).

As San Diego's population continued to grow, a rivalry developed between Southern California's two urban centers. While Los Angeles, and particularly MWD, were initially perceived as potential allies in San Diego's expansion, attempts to develop new water sources often sprung from a desire to break free from Los Angeles' influence (Gottlieb and FitzSimmons 1991). Thus began a decades-long conflict between what Walker calls the "regional" and "independence" approaches to San Diego's water supply issues (2004). While the regional approach argued that decisions should be made based on a Southern California agency consensus, the independence approach "accepted the basic fact that San Diego must always rely to some extent on MWD's imported water, but emphasized greater individuality and more freedom of action on water supply issues" (Walker 2004, 129).

As World War II strained local water supplies, San Diego (driven in large part by the US Navy) began to seek sources for water importation (Gottlieb and FitzSimmons 1991; Walker 2004). The San Diego County Water Authority (CWA) was formed in 1943 to seek new water sources, structuring itself (like MWD) as an agency relying on imported water. CWA faced a decision between two options for importing Colorado River water: building an aqueduct north to join MWD, or building an aqueduct east to join IID via the All American Canal. While many water industry insiders believed joining IID would be preferable to "an eternal second-place position behind Los Angeles" (Walker 2004, 49), the Defense Department resisted supporting an

Imperial Valley controlled by San Diego water interests, and pushed for CWA to join MWD's Colorado River Aqueduct (Gottlieb and FitzSimmons 1991; Hundley 2009).

In exchange for annexing to MWD, CWA was also required to relinquish its priority entitlement to Colorado River water to the larger agency, sparking concerns that San Diego had indeed accepted a secondary position in Southern California water seeking. As Gottlieb and FitzSimmons explain, "The use of water as a stimulant to growth was based on the argument that shortages 'could never happen here': with the system of preferential rights in place, the San Diego leaders feared that if such shortages should occur, San Diego would be the first to suffer. Preferential rights also reinforced the perception that San Diego was at 'the end of the pipeline' both literally and figuratively" (1991, 35).

Meanwhile, to the east, IID encouraged the growth and expansion of both irrigated crop production and individual fortunes through land sales policies, pricing policies, and attempts to develop the Salton Sea following the opening of the All-American Canal in 1941. This eventually transformed the region into one of the largest agricultural producers in the country, and IID into "the dominant economic and political force throughout the valley" (Gottlieb and FitzSimmons 1991, 77). Here, too, growth, prosperity, and water availability were intimately connected: "More substantial water use was perceived by the district [IID] and its landowner clients to be a reflection of the economic condition of the region" (Gottlieb and FitzSimmons 1991, 78). However, land holdings quickly concentrated in the hands of a small, powerful elite, while class tensions brewed (Barclay et al 1980; Hundley 1992). This era also saw the heyday of the Salton Sea as a recreational hotspot and major driver of regional tourism, despite failed attempts to develop it further. In the late 1950s, there was a concerted effort by speculators and

developers to build a "Salton Riviera" of resort cities, golf courses, and a marina for water sports. "The boom didn't last long, however," write Cohen et al, "and few homes were ever built. Lack of industry and infrastructure were problems, as well as the isolation, scorching heat, and sometimes-odorous waterfront environment" (1999, 5).

Late 20th Century Fall

The mid-century rise of Worster's hydraulic society faced a severe backlash in subsequent decades. In the latter half of the 20th century, major transformations in land ownership and land development came about as a result of a combination of social and environmental factors, most notably the national economic recession and energy crises in the 1970s, statewide population boom in the 1980s, and California's notorious boom and bust water cycle: large-scale droughts in 1976-1977, massive floods in the early 1980s, and another massive drought in 1988-1992.

This moment would have enormous impacts on California agriculture, development, and resource management for the next few decades. Agribusinesses were forced to sell formerly productive land in a buyer's market due to plummeting land vales in the 1970s (Gilmore 1998/99). Now that irrigated farmland was vastly devalued, land that wasn't suitable for restoration or preservation became available for whatever development could be sustained on it.[6]

---

[6] As Gilmore argues, this devalued farm land played a pivotal role in California's increasing importance for the growing prison system, with an explosion of facilities constructed on former farmland since 1982. The environmental history of California's prison system is an interesting case study on the intersection of race, land, and health. In addition to Gilmore's study in *The Gold Gulag*, recent years have seen a growing environmental justice movement around rising cases of valley fever in Southern California's prisons built on disturbed desert land. Valley fever is a fungal infection contracted by breathing in *Coccidioldes* spores from disturbed desert soil. Black men are 14 times more likely than white men to develop the deadly form of valley fever, and are incarcerated at disproportionately large rates, leading to a system where, activists argue, any prison sentence at a desert jail for a black man is functionally a death sentence (cf Ferry 2015).

California's water infrastructure was similarly imperiled. By the late 1970s, most existing water supplies had been committed; that is, the system used to allocate quantities of surface water to agency customers was reaching its breaking point, at least on paper. This ushered in the conditions of perpetual overcommitment and scarcity that have since become normalized and concretized in the ways Californians think about and manage water (Berk et al 1993). Indeed, environmental historians pinpoint this as the moment when cheap and abundant water was no longer seen as a birthright for all Californians, as voters drew on concerns from the rise of environmentalism (and its emphasis on the unanticipated costs of large infrastructure development) to critique growth for the sake of growth, reject new projects, and pressure agencies to better manage existing resources (Bakker 2014; Baumann 1983; Hundley 2009).

This rising environmental consciousness expanded beyond the insular world of water management, eventually touching nearly every aspect of how Californians sought to manage diminishing resources for a growing population during a time of environmental and economic scarcity. This tension between conservation and scarcity in public discourse is worth dwelling on here, for it would continue to shape an entire generation's apprehension of the environment as a source of resources to be maximized (land, water, and air), or a fragile ecosystem to be protected. Other major galvanizing texts had followed in the 10 years after the publication of *Silent Spring*, each in some way dealing with the ecological uprooting of human history, and mankind's uncertain future in the environment he has built for himself (Ehrlich 1968; Glacken 1967; Hardin 1968). Garrett Hardin's "Tragedy of the Commons" (1968) cast the problem in economic terms, theorizing that individuals will, in the course of acting independently and rationally in their own self-interest, deplete common resources and damage the future potential of the entire group. In

response, mankind must develop an ethic that recognizes all natural resources as inherently common and finite. By contrast, Paul Ehrlich's *The Population Bomb* (1968) presented a 20th century version of the Malthusian catastrophe argument for the same problem: the impact of growing populations on rapidly decreasing natural resources[7] (Ehrlich and Ehrlich 2009). While Ehrlich did believe that the United States' significant role in creating the problem gave it a moral obligation to lead the solution, he also advocated for a number of "triage" international policies that amounted to, at best, colonialism. Naturally, Ehrlich's essay incited Marxist critiques arguing that focusing on overpopulation and flat numbers overlooks that the real problem is not quantity of resources, but distribution. Through this lens, *The Population Bomb* is simply another instance of reifying social relations and erasing their history, as well as shuttling in oppression and genocide in the name of "the greater good."

Combined, these texts indicate a dramatic transformation of environmental politics following World War II, and a growing ecological consciousness in subsequent decades. The 1960s and 1970s saw a series of environmental laws and protections, most notably the Clean Air Act of 1963, the Wilderness Act of 1964, the National Environmental Policy Act of 1970, and the Water Quality Act of 1972. Together, these acts - and the historical moment that spawned them - form the foundation of the modern environmentalist movement's strategy of preservation through regulation. While the policy implications of these acts live on through ongoing processes of governance, their symbolic power seems newly (and perhaps differently) relevant now, in an

[7] Although Ehrlich's text is now the most well-known example of this argument, it was at the time the last and most bombastic in a line of texts about the same topic, and followed on the heels of Fairfield Osborn's *Our Plundered Planet* and William Vogt's *Road to Survival*, both published in 1948 and widely read (Desrochers and Hoffbauer 2009). Osborn's and Vogt's texts are early examples of apocalyptical environmental literature, and their focus on mankind as the ultimate destroyers of the natural world sparked a Malthusian revival in the post-War era. Interestingly, Desrochers and Hoffbauer trace the history of contemporary climate alarmism to this early post-War era.

age of relentless attempts to strip federal and state environmental agencies of their regulatory power over water, air, and land.

Returning to California's water world, this increasing environmental awareness led to critiques of water infrastructure growth and water agency institutional culture, and a growing interest in resource efficiency over expanded consumption. Governor Brown took office in 1975, emphasizing an era of limits for the water industry (Hundley 2009), and water agencies began receiving pressure from both the state and their constituents to explore greater conservation measures. At the same time, there still remained a dominant perception of abundance with regard to water supplies, particularly amongst water agencies and practitioners (Bruvold 1972; Gottlieb and FitzSimmons 1991). Now, however, this perception emerged as an assumption that *imported* water from other states would continue to be available to meet any increase in water demand. In the 1970s, and from an agency perspective, water conservation was still seen as a voluntary, secondary goal. By the 1980s, however, "the large water development project had reached the same impasse as had the big power plants, a casualty of escalating costs, environmental impacts, and new public agendas" (Gottlieb and FitzSimmons 1991, 193). The "slow growth" movement gained traction, particularly in San Diego during the 1980s (Walker 2004), and both MWD and CWA faced greater public attention, participation, and criticism than ever before (Gottlieb and Fitzsimmons 1991).

Meanwhile, during the 1970s and 1980s, the Salton Sea saw widespread flooding, increasing salinity and toxicity from agricultural waste, a 50% drop in recreational use since the 1960s, and a new identity as a disaster zone in need of saving (Cohen et al 1999; Glenn et al 1999). By 1984, and in response to what many perceived to be a potential collapse for the area,

Imperial Valley had "become a hotbed once again for entrepreneurs, speculators, and large firms interested in transforming water (specifically, conserved water) into profit" by selling water to coastal, urban areas (Gottlieb and FitzSimmons 1991, 81). Although there was early enthusiasm for water markets - and particularly for sales to San Diego, which would continue the special relationship between water and land development insiders in the two counties - any plans were still in the negotiation stage. Even so, the potential for speculation over water drew even more attention to the growing disparity between an elite group of large landowners, and other Valley residents.

Market Environmentalism

Interest in water efficiency (in the form of water markets) continued to grow during the 1980s, along with rising critiques of the hydraulic society paradigm. By the time the 1988-1992 drought hit, forcing a widespread shift in perspective as to California's "true" water situation, the stage was set for an epoch of water economization. This coincided with a nationwide shift towards neoliberalism and public choice theory in public policy, and with a specific shift in perspectives and explanatory models of water. Water had been viewed as an economic good, "a necessary factor of production that must be put to private use in order to be socially useful" (Gottlieb and FitzSimmons 1991, 173); but was now, following the environmentalist critiques of growth, also viewed as a public good that should be managed according to principles of equity (Bakker 2014). Balancing these two valuations (and, in fact, viewing them as "valuations" in the first place) is part of an epistemic shift Bakker refers to as "market environmentalism," the successor to the hydraulic society paradigm. "The goal of market

environmentalism," she writes, "is to achieve positive environmental outcomes through the introduction of markets and market-derived institutions and organizations" (2014, 475). Embedded in this new explanatory model of water is a powerful critique of the logic underlying hydraulic society: "that the ever-increasing supply-side logic served to create (rather than solve) water crises" (Bakker 2014, 471).

The 1988-1992 drought, then the most significant drought in California's recorded history, further forced the conversation on conservation, efficiency, and controlling growth. That said, it's worth noting that the impacts of the drought were not felt equally across Southern California. As Gottlieb and FitzSimmons note, "In 1976-1977 and 1986-1990, when other urban areas in California found water so scarce that they imposed sometimes severe mandatory rationing on their water users, Southern Californians faced no such imposed restrictions. Only after the dry period, which began in 1986, seemed likely to extend a fifth year did the MWD board approve a small mandatory cutback in deliveries to member agencies" (1991, xvi). The drought did, however, provide an enormous opportunity to experiment with ways of redistributing water and decreasing demand during times of scarcity, inspiring a flood of literature on block pricing, water markets, water banking, and water transfer models that continues today (Dellapenna 2000; Gleick et al 2003; Howitt 1994; Israel and Lund 1995; Pint 1999).

In the aftermath of the 1988-1992 drought, Southern California reached something of a turning point in water attitudes, perspectives, and practices. As previous decades' critiques of growth and promotion of market environmentalism continued to grow, new debates over how to value and allocate scarce water supplies sparked fragmentation, regionalism between local water systems, and a "crisis of accountability" between water agencies and water users. There was a

growing realization of just how water intensive the urban Southern California lifestyle had become, and whether the easy availability of water had been taken for granted. Then, as now, scholars speculated as to whether this willful ignorance had something to do with residents being geographically and symbolically separated from the "true" source of their (largely imported) water (Waller 1994).

Naturally, the drought forced those outside of the scholarly literature to reconsider the impacts of water scarcity as well. In Imperial Valley, the already significant gap between elite water industry insiders (and their allegiance to traditional water management approaches that privileged large land owners) and rank-and-file water users became clearer. Waller takes the drought as a major turning point for the Imperial Valley area, bringing these existing conflicts to a head. He writes, "The failure to adapt to the social changes California has experienced widened the gulf between the region's changing water demands and cultural values and the traditional approaches to water management, allocation and consumption" (1994, 13). Interestingly, Waller locates part of the problem in the increasingly technical expert language of water management, designed to exclude the public (and specifically, I would add, members of the public already excluded from the white-collar world of technical bureaucracy and hierarchical civil society) from participation. He continues, "it took a crisis to expose the inadequacies of the status quo, undermine the authority of the experts, and mobilize the public to assert their interests" (Waller 1994, 13).

In fact, across Southern California, the long-established water industry system was coming under challenge, and a new water policy process began to emerge. Water agencies had to rethink how to defined and approach their publics, and public relations became a prominent focus of

agency work (Gottlieb and FitzSimmons 1991). This is not to suggest that agencies suddenly became fully accountable to the public. In particular, MWD and CWA's status as "pass-through" agencies, dealing with imported water and member agencies and municipalities rather than individual consumers, meant that they continued to remove themselves from public scrutiny. Similarly, despite the emphasis on public relations, "Water issues continue to be defined in 'technical' terms, that is, as dependent on expertise, with policy matter then to be settled within discrete, 'apolitical' agencies (often still responsive to their old constituencies)" (Gottlieb and FitzSimmons 1991, 106-107). Outside of agency boardrooms, this meant that discussions of water problems in Southern California occurred almost exclusively in technical language inaccessible to non-experts, a trend that is also reflected in the scholarly literature's trend towards economic and engineering frameworks.

Fragmentation and Regionalism

The 1990s saw further fragmentation and regionalism in Southern California water politics, which shaped many of the conflicts that play out at the community level in subsequent chapters, as smaller players in the waterscape seek to make themselves and the scale of their local water matter in a water world dominated by megacities, large-scale infrastructure, and agencies that manage entire regions. The already uneasy alliances between Southern California water agencies (as well as between Los Angeles and San Diego) fragmented further amid concerns over water independence and reallocation. At a broader regional scale, urban interests increasingly overtook rural ones in Southern California water development (Gottlieb and FitzSimmons 1991, xviii), and rural vs. urban use debates were reignited via criticisms of subsidized water for rural use in

Imperial Valley, and accusations of inequities in agency technical compliance (Walker 2004). Walker identifies this conflict as making explicit the greater value attached to "more efficient" urban water use (and urban water users) over "wasteful" rural water use (and rural water users). On the transfer of water from IID to San Diego, he writes, "It makes little sense for precious water to be wasted when the demand in urban areas is so heavy. Inherent in much of western water law is a doctrine held high in an arid land that no one has a right to waste water and use it inefficiently" (Walker 2004, 127).

This fracturing and localism between water systems was mirrored by a growing regionalism written into water management and policy, bolstered by a (supposedly) more environmentally conscious focus on hydrologic boundaries over agency ones. "Watershed management"-style initiatives proliferated, bringing stakeholders from public and private agencies together on regional issues (Kenney 1999). State-sponsored projects like Integrated Regional Water Management (IRWM) and later the Sustainable Groundwater Management Act (SGMA) further instantiated the regional system, shifting the structural features of the water management network (Blomquist 1992; Hughes and Pincetl 2014).

Imperial Valley and the Salton Sea provide an example of how these discourses about water values, environmentalism, regionalism, and reallocation interacted in practice, particularly in a place already undergoing significant change and conflict. The 1990s saw another flood of studies on the Salton Sea, largely completed by various state and partner agencies, and largely focusing on the importance of the ecosystem locally and regionally. With the Bureau of Reclamation and the newly created Salton Sea Authority leading restoration planning, objectives were developed to balance and coordinate the multiple roles of the Sea; preserving its value as

both an agricultural sump and a recreational and wildlife hotspot, and increasing the economic potential of a region that had seen rapidly increasing poverty. While the ecological/ environmentalist perspective is a noticeable shift compared to previous efforts, it's also important to note the growing focus on environmental justice and social equity for residents other than large landowners (the focus on environmental justice, in particular, coincides with nationwide trends of the time, and with the rise of mainstream environmental justice advocacy from civil rights-era activism in response to environmental racism). Cohen et al.'s lengthy report for the Pacific Institute, for example, certainly focuses on ecological concerns, but also gives ample attention to demographics and vulnerability (1999, 7).

Conclusion

Historical and contemporary literature suggests that California has indeed reached a "new" era of water management following the fracturing of the Southern California water leaders in the mid-1980s, and the flood of regulatory and policy changes during and after the 1987-1992 drought (Hundley 2009; Waller 1994). There are signs that previous decades' agenda of growth has finally reached an impasse, with the new era shaped by recent trends toward decentralization and regionalism like IRWM, increased economization, the need to shift structural changes to lifestyles made possible by intensive water use, and a strong emphasis on conservation and efficiency over importation.

This new era is marked by a "tipping point" narrative like the one with which I opened this chapter, which claims that policy makers and practitioners are forced to fundamentally rethink the way they manage water. It is perhaps not surprising that I witnessed a sharp increase in this

tipping point discourse as the 2011-2017 drought intensified, and the environment itself surfaced longstanding problems in policy, technology, and advocacy. As Worster noted in 1982, "Most ancient hydraulic empires collapsed at the point when there were mounting ecological difficulties and a lag or breakdown in the managerial skill needed to meet them" (514). Accordingly, the tipping point relies on a strong historical narrative of how water *used to be* in California, reinforced by continued scholarly focus on particular historical periods (like the 1920s, as in Hundley 2009; Kahrl 1982; Starr 1990), and figures (like William Mulholland, as in Davis 1994 and Mulholland 2000) or cases (like Owens Valley, as in Kahrl 1982) that define the essential qualities of water in California. This continued politicization of water through the writing of its history emerges also in work that lists California's charismatic and powerfully entrenched water past as part of the problem in managing water today (AghaKouchak 2015; Gottlieb and FitzSimmons 1991; Ingram and Oggins 1992; Merchant 1998; Mulholland 2000; Reisner 1997; State Water Resources Control Board 2013; Waller 1994).[8]

Water Ecologies

In essence, the tipping point narrative foretells the end of "traditional" water supply and management structures, where the water supply would be increased through centralized planning and funding to meet demand ad infinitum (Baumann 1983; Hanak et al 2011). These structural,

[8] Within the scholarly literature, this ability of history to overdetermine the present can have two effects. First, as noted by Mulholland in her biography of William Mulholland, particular perspectives and explanatory models of California water may be repeated so frequently that they become treated as fact by researchers, regardless of evidence (2000). Second, once these subjective perspectives and explanatory models gain the symbolic power of fact, they may continue to be treated as such in policy and practitioner circles, regardless of revisions to scholarly literature. On this latter point, some water researchers note that practitioners and policy makers have been slow to notice trends that were visible in environmentalist, scientific, and/or public health circles much earlier (Getches 1987; Hanak et al 2011).

systemic problems only exacerbate the impacts of the 2011-2017 drought, such that "now the state is nearing its water limits and can no longer simply build its way out" (AghaKouchak et al 2015, 410). Instead, and as I documented across community water districts, scientific conferences, and large water agencies, the tipping point narrative has sparked a strain of research and commentary on the need to transition from new source development and dam building to so-called "soft" infrastructure: balanced, flexible, adaptive interventions carried out through policy, education, community engagement, economic incentives, and efficiency improvements, often at the local level (Gleick 2003; Hanak et al 2011; Kallis et al 2009). Appropriately enough, this move coincides with a broader growing regionalism in California civic life, "based on participatory, inclusive and partnership models of governance" (Jonas and Pincetl 2006).

It's interesting to note that our present ground-up, regional iteration of California water might itself be analyzed ecologically; that is, in terms of relations between particularly situated, specific waters that relate to each other ecologically through comparability without commensurability. On the one hand, California water is still largely managed according to the large-scale systems logic of past eras, as seen in particular in the rise of sustainability and efficiency as institutionalized values. Sustainability is defined in terms of balance and compromise, an outgrowth of previous' decades focus on cooperation and assessing the value of different water uses. Similarly, efficiency emerged first as a means to release "surplus" water supplies, and later in response to the relative failure of voluntary long-term conservation measures; in effect, efficiency is conservation without the need to cut back on production. The rise of water sales and transfers to move water between geographically distant nodes is another example, operating on the understanding that all water is the same everywhere. On the other

hand, the system is not that simple. Scientists and practitioners insist that California water is a complex, multi-scalar system of systems that can (and should) be managed according to multiple interventions and political/legal strategies. The rise of integrated resource management planning at the level of the watershed (IRWM) and groundwater basin (SGMA) speaks to this point: an adaptive approach melding hydrological and political/administrative boundaries to balance supply and demand, while recognizing the need to adapt to the local needs of specific watersheds and basins, and emphasizing keeping local water in local places.

This last point - the idea of local water, and its connection to local power and local ways of life - has emerged as perhaps the most powerful driver for reconsidering the complex historical relationships between California water and California ways of life. As urban, suburban, agricultural, and wilderness areas are increasingly perceived and managed very differently in terms of both infrastructure and policy and education needs, the gaps between their advocates widen. As will be seen in subsequent chapters, policies and management decisions that prioritize one use over another - a common feature of drought and water emergency - risk further exacerbating already tense regional dynamics and creating political deadlocks (Reisner 1997). Prioritizing one use over another is effectively choosing between radically different futures for particular regions, and for California as a whole.

SUMMER: HEAT

The sound of summer is air conditioning.

Last night, I couldn't sleep. Even after the sun sets and night falls, the ground retains the heat, spilling it back out into the air. The walls are still warm to the touch. The little air conditioning unit in my bedroom at the field station tries, but it can only manage to cool the room for a few minutes before the heat leeches in, beginning the process all over again. It's distracting, this constant failure to equalize the temperature one way or the other. Maybe tonight I will sleep outside. The weather forecast says that the nighttime temperature still hovers around 80 degrees.

Carl, a local developer, believes that energy for climate control is the single most important issue for Smoketree's future sustainability. The town has become something of a field test site for energy projects, but has yet to see any real benefits. They still experience regular brownouts. He worries about the impact of summer energy costs on small businesses, like his tenants in the restaurant in the center of town, whose power bill soars to $6,000 a month as soon as the heat spikes. How can they afford to stay open during the low season, when locals stay in hiding and few tourists brave the desert heat? How can your town be successful when the environment itself effectively prices you out?

It's mind numbing, the alternating buzzes and hums and glitches of the three separate air conditioning units within ear shot. The charismatic silence of the desert is gone, replaced by the industrial drone of uneasy human habitation. And then, suddenly, it is quiet again, with the

sleepy warmth of that heat that never really leaves bearing down on me. Even the lizards are hiding in the shade.

Light and heat are a constant, lulling presence, so much so that it becomes easy to forget just how dangerous they can be. Everyone has a favorite story of some hapless visitor (and it is always a visitor), who nearly died because they underestimated the desert. Andy, a retired park ranger, once chased down a trail runner from Colorado, who attempted to go for an afternoon jog with only an orange for water replenishment. Andy looked him straight in the eyes, and told him he'd better turn right around because Andy didn't feel like hauling his dead body back to the trailhead later. Stories from Sandra, a local businesswoman, generally feature European tourists searching for the unique extremes of the American desert. One day, a German stumbled in to the Chamber of Commerce, red faced and sweating, gesturing wildly to a picture on his cellphone and repeating "where is the dragon?!" Sandra forced him to sit under the air conditioner and drink glass after glass of water, while she flipped through a brochure to show him directions to a large metal dragon sculpture at the edge of town. "Some of these people, they come from places where you don't ever have to turn the air conditioner on in the car," she explains, "And so they get hot, and it doesn't even *occur* to them to try and cool themselves down!" After the dragon incident, Sandra started a summer awareness campaign. A bright orange sign baring a skull and crossbones and the slogan "10 MINUTES FROM DEATH" now decorates the Chamber's main entrance.

Extreme adventurers aside, the pace of everyday life stretches and slows in the summer. Locals learn to structure their days and seasons around this fact. Bodies move through the soupy hot air like water, the mind reacts slowly or not at all, and time itself seems to warp and ripple in

the sun. It's a pleasurable attenuation, to be surrounded by unrelenting heat and light. Even your joints seem to expand and relax. The fear of drying up in the desert seems far less frightening in the moment.

CHAPTER 2: FOSSIL WATER

"The world around us is clearly one of change, irreducible to models. Who is trained to steadily wait upon and translate them for others, these vibrations of deeper time?"

Guldi and Armitage 2014, 3

Introduction

Helen and I have packed ourselves in to her small white Honda Fit, and begun her annual pilgrimage across Southern California's rural desert lands. We set out from her sprawling homestead in the Yuha Desert, down by the US/Mexico border, then arc north along the shores of the Salton Sea and across the high desert passes of the Mojave, finally reaching our zenith at the edge of Death Valley. The tiny car feels more like a submarine on these empty, sunbaked roads; a climate-controlled bubble insulating us from an indifferent desert, as we pass by dried up orchards and broken down homesteads.

Helen is a retired schoolteacher, who fell in love with the desert during a Peace Corps stint in Botswana, and has dedicated her life to protecting this landscape and the people who live in it. Much of her work involves water protection, and our journey has become a tour of the many battlegrounds in the region's water wars. "Most of these places have sole-source aquifers," she explains, referring to the EPA designation that prevents contamination of a community's primary drinking water. Helen has fought for years to protect her own local aquifer in Palo Verde from toxic mining waste, and is constantly at odds with those who consider water so abundant as to be functionally disposable. "They're on fossil groundwater! People have this idea that every time it rains, it [the groundwater aquifer] recharges, so we're drinking the rain water. And no, we're drinking water that pre-dates human civilization! We're drinking water that fell from the sky at

the end of the last Ice Age. The last significant recharge to that basin was when there were mammoths here!"

As we crest a particularly spectacular mountain pass, the landscape opens up in front of us. A ring of tall brown, red, and tan mountains slowly crumbles in to the sloping valleys below. Darker colored sediments spill from the cracks and gullies on the sides of the mountains, snaking down to the valley as traces from flash floods. Helen reads the traces of water in the desert landscape like an archive. "You can see where the water used to be, where it goes after it rains, where the floods went," she continues, pointing to features alongside the road, "That low spot used to be a lake! This is what I love about the desert. You can see all the history and the geology."

Like most water experts I've met here, Helen slips between geological and human modes of keeping time in her narration of water problems, drawing on water's slippery materiality to make particular claims about its temporality. Her framing of groundwater as fossil water is a common practice, where fossilization both indicates the water's age relative to humans, and comments on the significance of that age for water's use as a particular kind of human resource. Groundwater aquifers are water deposits stored in the soil and rock layers beneath the earth's surface, and extracted by pumping from a well. These aquifers form through a slow process of accumulation, where water continually fills the spaces in between the soil and rocks enough to pool together and saturate the ground beneath the water table. The time it takes water from the surface to reach the aquifer depends on the local geology. If the aquifer is very near to the surface in a rainy area, it can be replenished (or refilled) in hours or days. If the aquifer is deeper and in a dry area, it can take hundreds or even thousands of years, assuming the water doesn't

evaporate off the ground first. Fossil water refers to groundwater that infiltrated in the distant past - generally within the Holocene and Pleistocene, or 10,000 to 40,000 years ago - and has remained largely undisturbed since. Since water is not itself a living organism, the "fossil" in fossil water does not indicate the preservation of biotic matter, but rather an equivalent passage of time from the water's initial deposition in a particular place. It serves as a specific invocation of water's geological history; a trace of prehistoric rain, or a trace of a world very different from our current one. Taken as a conceptual model within a geological cosmology, it allows for a kind of fossil water taphonomy; a study of the material processes by which this waterscape came to be what and where it is now, enlivening particular interactions between groundwater and the living and non-living things around it.

This is a story about modeling renewable, non-renewable, and sustainable resource use; about thinking with deep geological time on the scale of individual careers and lifetimes. But, it is also a story about struggling to live with water in an extreme environment defined by a perpetual lack of water; and about the stakes of fighting for long-term futures during a drought, in a place shaped by social, political, and economic cycles of boom and bust. The term "fossil water" invokes finality, scientific authority, and symbolic and material linkages to the distant past and potential future; all powerful connotations in the context of the California drought. But, what does it mean to live with this model of water's temporality and materiality? To think critically about fossil water's persistence, resurgence, or attenuation at a time when dynamic balance and sustainability are rapidly becoming the dominant ways of thinking about environmental temporality? Within this register, it becomes clear that water cannot be understood as a singular object; there are ontologically different kinds of water, and we cannot analyze water without

modifiers pertaining to its spatiality or temporality. While surface water and groundwater are primarily place-based, *fossil* groundwater is primarily time-based. As such, the temporal modifier fundamentally shifts how water emerges in practice, and gets scaled as a natural resource. While surface water can be (and generally is) managed as a renewable resource on a cyclical timeline, fossil groundwater is functionally non-renewable, and managed on an entirely separate, more linear, and perhaps more geological timescale. From the ground, then, communities dependent on groundwater become disarticulated and isolated from the larger political, infrastructural, and hydrological system that is California water, both spatially and temporally.

In what follows, I draw on ethnographic fieldwork conducted with geologists, paleontoloogists, and water activists to examine practices of water time reckoning, paying special attention to claims of how water "works" in the desert, how that work is made visible, and how it connects people, places, and things across time. My data draw from three very different rural desert communities: Smoketree, a resort town and hub for citizen science; Mesquite, a former mining and railroad outpost; and Palo Verde, an aging community stuck in an industrial development zone. Collectively, these places represent a sort of regional cross-section of fossil water science and cultural politics in the Southern California desert. I begin with the geological cosmology that animates fossil water, and how fossilization serves as a conceptual model for old groundwater. Then, I examine two interrelated manifestations of the fossil water model: fossil water as fossil fuel, and fossil water as trace of deep time. Along the way, I attend to how fossils and fossil water become slippery reference points for the history that unfolds around them, displacing and reorganizing the relationships between people, places, and things in the present.

Water Time Reckoning

Stories about how water works in the desert - the prehistoric lake that dries up, the fossil groundwater that can't be replenished, the flash flood that suddenly reshapes the canyon - are inevitably models for a specific and particular desert water "temporalization" (Munn 1992). They define reference points or axes of orientation for everyday practices of "attending to" the past, present, and future of desert life (ibid). Here, my focus is less on practices of telling time or marking the passage of time than on temporal *dating*: determining and attending to relative timelines. In this sense, fossils and fossilization become unexpected reference points for figuring water time, where waters like groundwater, rivers, and floods that are materially identical are marked as temporally different, both in themselves and in terms of what they afford for human use (and for how long).

We generally figure water as a biological and historical object: water is the forms of life it supports, or water is what humans or non-humans have done with or to it. But, desert water models in general (and fossil water in particular) remind us that water *itself* exists on a larger, slower, geological timescale, where living and non-living things move in and out of a chemical and physical system. The question then becomes, as Helen intimated, what is the role of human water users on that timescale, somewhere in between a watery past and a dried up future?

Water Time

Water is a particularly interesting case study for thinking about temporal modeling practices. Despite the taken-for-granted spatial and temporal scale of water as a managed object,

an STS perspective suggests that water is multiple - "not only in its meanings, but more importantly, in its very materiality" (Barnes and Alatout 2012:484). Viewed in these terms, water "is not a singular object of epistemology for which abstract knowledge can be produced and circulated in all times and places without interruption…Rather, water reveals its complex, multilayered biophysical identities for particular enactments depending on assemblages that are in place or still in the making" (Barnes and Alatout 2012, 484-485). In other words, water is a singular object with multiple ontologies, enacted differently at different moments across time and space (Alatout 2010; Jørgensen 2013). It is both a fundamental part of nature, and subject to interventions that shift its flow and movement as a natural resource necessary for the organization of life in late modernity (Bakker 2012; Barnes 2012; Bikjer 2012).

In the context of managing groundwater resources for large-scale long-term human use, this raises questions of the relationship between humans and the total environment (as detailed also in Chapter One). In *Silent Spring*, an early example of this perspective on water, Rachel Carson uses case studies of water pollution to demonstrate the true spatial and temporal scale of the total environment concept. Water, she explains, moves through a cycle from groundwater to precipitation, and in its circulation supports all forms of life "in an endless cyclic transfer of materials from life to life" (1994, 46). The problem of water pollution, then, is quite literally a problem of the pollution of everything at every scale: "It is not possible to add pesticides to water anywhere without threatening the purity of water everywhere" (Carson 1994, 42). Through this engagement with the material properties of flowing water, Carson pinpoints the same essential problem in any attempt to study water: how are we to analytically define the boundaries of an object that carries a particular material symbolic value in a particular place and time, but

also continually transcends that place and time? If we orient to water as property or resource that is dammed, diverted, replenished, or polluted, how are we defining it spatially and temporally?

This take on a managed environment also implies a shifting view of change over time, and a shifting view of human time in relation to natural change. Hazards occur over the long scale of time: cumulative exposure to toxins, slow changes in the ecosystem, remaking of genetic code. What is safe today may not be safe tomorrow. Thus, the "whole environment" requires a sense of the "whole span" of time, where the present environment is a function of the past, the present, and, in what Carson calls an "obligation to endure," the potential future. "Given time - time not in years but in millennia - life adjusts, and a balance has been reached. For time is the essential ingredient; but in the modern world there is no time" (1994, 6). In other words, human actions have not only tipped the ecological balance of nature, but accelerated the pace of ecological time so much that balance may no longer be reached at all. This sense of the end of time (and the end of any possibility of balance) is not dissimilar from the tension between the imminent end of a functionally finite water resource, and the potential end of the possibility of a balanced water cycle.

Desert Time

Water and temporality are inextricably linked in the desert. In "The Desert and I: A Study in Affinity," geographer Yi-Fu Tuan writes "I have come to see that the desert's profound appeal to me lies not only in its pure lines and ease of orientation but in barrenness itself" (2001). This barrenness materializes time - and, more specifically, timelessness - as a function of empty, indifferent, imperturbable space, impossible large and old relative to humans. "In the desert,"

Tuan writes, “ruins last longer than they do in humid regions. In this sense, they endure. But they endure as ruins.” This sense of time as persistence, slowness, and longevity implies an uncertain understanding of the basic scientific relationship between cause and effect, but, as Tuan implies, this sense of causality is only strange relative to human assumptions of how things “should” work. Tuan’s treatment of the desert remains as an affective landscape, not quite Helmreich’s ocean that is both affine and alien, but still possessing its own cosmology and temporal rhythms. As locals often reminded me, from dormant plant seeds to backdoor political influences, “things last forever out in the desert.” It’s never entirely clear whether ecological or political objects are, in fact, dead, which presents certain challenges for planning and executing any kind of environmental interventions.

Furthermore, and also implied in Tuan’s description of ruins, there is the sense that biological states like being alive or dead aren’t quite applicable to the harsh desert environment (2001). Fossilization operates in an interesting way here as a shift from bios to geos; an extreme attenuation of the process of something alive becoming no longer identifiable as living, but perhaps still very present through its material traces and effects. Writing on the use of trace fossils for marking extinction events and epochal transitions, Laura Ogden explains, “Trace fossils are a way of marking time via loss…they both mark presence, of being in the world, while simultaneously conveying absence. Trace fossils articulate the past and the present not through a kind of continuous temporal relation, but one where the past and the present are at play (in the Derridian sense of the trace)” (Ogden 2016).

The relations between these different forms of water time reckoning also raise questions of temporal comparison and relativism. What does it mean to claim one environmental object is

older or somehow operating on a different timescale than another one? What are the different points of reference between timescales, and how are those differences made meaningful in practice? Like comparative relativisms, attention to these comparative temporalizations can ask "both what knowledge or truth is being imagined relative to and whether comparison always operates in the "same" way—or with the same grounds or purposes (e.g., shoring up the categories of culture, nature, morality) wherever we find it" (Helmreich 2012, 1130).

Groundwater Temporalities

In practice, groundwater is apprehended through a combination of direct measurements (dropping a measuring tape down a well at different time points to track changes in the water level) and inferences based on local geology and analogous systems. Water technicians and managers combine this data with estimates of how much water is pumped out of the aquifer every year to calculate three crucial numbers: 1) how fast the water level drops from year to year, 2) the degree of "overdraft," or the difference between how much water is taken out and how much water is replenished over a year, and 3) how many years of water are left at the current rate of use. In short, as a resource, groundwater is understood and managed in terms of how the water supply changes over time. Individual groundwater basins in California have generally been modeled and managed in terms of reducing the overdraft so as to expand the number of years of water left - essentially, to stretch and manipulate a resource already assumed to be finite.

Illustration 2.1: A Department of Water Resources field geologist measures the water levels at a monitoring well in Smoketree. Twice every year, a DWR team takes measurements at wells across Smoketree Valley to chart changes over time.

Conceptualizing groundwater in terms of change over time is hardly a new practice in the western United States. As Reisner wrote of western water developers in the early 20th century, "The states knew the groundwater couldn't last forever…so, like the Saudis with their oil, they had to decide how long to *make* it last" (1993, 10, emphasis mine). This practice reflects the special place that groundwater occupies within California scientific and political registers, separated symbolically (if not always materially) from the visible surface infrastructure of rivers, dams, aqueducts, and reservoirs (Giordano 2009; Hundley 1992). Instead, groundwater is operationalized as a kind of self-contained local water like a river or a lake, geographically bounded and driving a distinct sense of place (Opie 1993; Orlove 2002; Raffles 2002). More

specifically, *desert* groundwater is thought to behave in largely predictable (or at least comparable) ways, affording particular forms of social life by virtue of its material properties (Geertz 1972; McCool 2012). Groundwater's specialness is perhaps most obvious in technical scientific and policy discourse, but emerges also through everyday talk about groundwater socialities, as when Helen characterizes small desert communities as places with sole-source aquifers (whose residents should therefore behave in specific ways), or when local water stakeholders focus their political appeals on elected officials with direct experience living off groundwater, rather than those who grew up in urban areas.

With the 2011-2016 drought, however, came a new paradigm of groundwater management and another layer of temporalization: one based on climate predictions, policy implementation schedules, and water use benchmarks. In the three years since Helen and I first met, unprecedented conservation measures and sustainability mandates from state and county agencies drove new and shifting modalities of understanding, modeling, and managing water on ever more urgent timescales. In 2014, the state instituted the Sustainable Groundwater Management Act, requiring sustainability timelines for the state's notoriously (and, as Helen and others claimed, dangerously) under-managed groundwater supplies. SGMA required local water agencies to adhere to state-wide timelines and priority designations for groundwater basins, and to develop Groundwater Sustainability Plans in accordance with state-determined standards and models of sustainable water use. In response, small rural communities in Southern California's groundwater-dependent desert regions struggled to reconcile their existing explanatory models of what groundwater is and how it works with the new models for sustainability. Locals were confronted with a proliferation of competing and overlapping models of groundwater

temporalities, such as: conceptual models of non-renewable "fossil water" pumped from the ground like oil; technocratic sustainability models of "zeroing out" inflow and outflow; and geological models of the desert landscape as an archive, revealing where ancient waters used to flow.

As detailed in Chapter Three (Number Narratives), groundwater sustainability is defined across scientific, technical, and political registers through a conceptual model of balance: quantity of water in minus quantity of water out equals zero. The problem was that this model of groundwater temporality as sustainability - the ideal water cycle, an endless flat circle of water use and return - seemed fundamentally at odds with the water temporalities already in use. All of the sudden, scientists, water technicians, and local experts alike confronted a question that seemed paradoxical: can the continued extraction of fossil groundwater ever be made sustainable in the long term? Or, in categorical terms, is all water on earth part of an ecological cycle that continually renews itself, or must these ancient groundwater aquifers instead be studied, modeled, and managed on a different, more geological timescale?

Fossilization

Fossilization encompasses a process of change: the solidification and preservation of traces of a living organism in material that is no longer alive. Taphonomy is the study of the processes of fossilization: what happens to that organism after its death and until its discovery as a fossil (or, presumably, until the point at which it's no longer recognizable as something that was once alive). But, how does water become a kind of fossil?

"Extremely Geological" Places

I first encountered the idea of fossil water in Smoketree, a resort town with a vibrant citizen science community. While Smoketree has its share of amateur ornithologists and botanists, geology and paleontology are the most prestigious part-time occupations. Smoketree State Park includes a paleontology laboratory (run by the State Park system's only full-time paleontologist), which hosts an almost complete collection of specimens from the surrounding Colorado Desert region. A sub-division of the Park's volunteer organization even offers an extensive certification course taught by local experts; volunteers who complete the course are able to gather and preserve their own specimens for the Park's collections. The paleontology program generally attracted retired professionals from highly technical fields (my "cohort" included a retired engineer, a retired nurse practitioner, and a GIS instructor), many of whom would go on to develop a special, nearly obsessive affinity for a particular species. George Murray, for example, retired to Smoketree from his dentist practice, became interested in paleontology, and built a second career as one of the world's foremost experts on mammoth teeth (helped along by Smoketree Park's impressive collection of mammoth specimens).

In addition to Smoketree's 60-odd amateur paleontologists, a number of professional geologists and paleontologists have conducted research in the broader Smoketree Springs Valley, which is itself significant within the scientific community for possessing "the most continuous history of life for the last seven million years in North America" (Jefferson and Lindsay 2006, xi). This "long complete history," as described to me in a well-practiced narration by local celebrity geologist Lowell Lindsay, is due in large part to the "pliers" formed by the land masses

that today surround the Gulf of California, which over time trapped water and water-based forms of life, providing a sort of geological forcing function.

It's interesting to note the central importance of water for the fossil record, particularly given that water is one of the largest effectors of geological change at every scale. "The Colorado Desert of southeastern California was not always a seemingly barren wilderness," explain Jefferson and Lindsay (2006, xi). "This was once a verdant landscape - an environment of rivers and streams, lakes, forest, and savanna. Before that it held an inland ocean. The key to understanding and engaging this prehistoric world is paleontology, the study of the fossilized remains of ancient life" (ibid). The uninterrupted fossil record is also an uninterrupted record of water, and the contemporary aquifer is a material trace of that record.

This narrative of significance by virtue of persistence - something like Tim Choy's description of endemism, the special status afforded to certain forms of life that fail to appear anywhere else, and "come to matter as objects of knowledge and love" explicitly defined by relation to their residence in a particular, and thus also special, ecology (2011, 27) - was one I heard frequently from locals interested in local environmental history and citizen science, particularly as a way of teaching listeners how to discern the significance of Smoketree Springs Valley from the surrounding desert and broader region. Smoketree is a place that is "extremely geological," a descriptor used to indicate both a source of important geological and paleontological specimens, and a producer and exporter of knowledge and stories. In this sense, the Smoketree Springs Valley itself becomes a regional index specimen, the stable reference point around which the rest of the region's temporal dating turns.

Dating Rocks and Water

Illustration 2.2: Following the water. Amateur paleontologists follow a wash in the badlands outside of Smoketree, hunting for fossilized wood.

Our first classroom lecture in the paleontology certification program has a deceptively simple topic: rocks. This lecture is given by Murray, a retired Park geologist with sunbaked skin and a grizzled ponytail and beard (a look shared by so many of the geologists and paleontologists that I begin to think of it, along with a battered baseball cap and safari shirt with Park insignia, as part of the official uniform), one of the many trained geologists responsible for what we know of Smoketree's geological history. Rocks, he explains, are important to fossil finding because they tell us about *context*: the conditions of burial, where things were, what was going on, and how the fossil has traveled from its original location. Drawing on the small chalkboard produced from the back of the lab classroom, he runs us through a quick and dirty process of identifying minerals, and kinds of igneous and metamorphic rocks. I notice my fellow students' eyes begin to glaze over; even for an introduction, this is information overload, and we're having trouble following the many charts and diagrams in our notes. Perhaps counterintuitively, I'm struck by just how unspecific and

relative the entire process seems. Mineral hardness is defined relative to other minerals. The timeline of the entire Smoketree Valley is based on a rock deposit that was dated from a similar rock deposit somewhere else. Identification is a process of figuring out where your sample is relative to other known samples, which are themselves only known through relations to even more samples. The best place to find a fossil is where fossils have already been found. Confused, I scribble in my lecture notes, "How do they not know what this rock is?! Can't you just figure out *what and when it is*?"

Thinking water as a fossil, despite its resistance to literal fossilization, also reveals how water exceeds standard geological dating practices. At its most basic level, dating a rock or a fossil consists of fixing a time at which something occurred. There are two methods for dating objects: relative dating (is this thing older or younger than that thing over there?), and absolute dating (how many years ago did this thing form?), although, of course, it could be argued that absolute dating is just relative dating with a lesser production of scientific uncertainty. While both relative and absolute dating are used, in practice, as Murray explains, dating is treated as absolute in the way that we talk about particular specimens or rock formations.

Water is both a critical means of dating the rocks and fossils around it - known water features serve as fixed chronological reference points, and water movement is one of the strongest taphonomic forces - and an object that cannot itself be dated with a high degree of accuracy. Relative dating is based on a combination of known local geology and the "Law of Superposition," which states that the oldest things are generally on the bottom, and the youngest things are generally on top. This holds for groundwater as well: treating flows of water like flows of sedimentary rocks, fossil water becomes stratigraphic, with the "oldest" water deposited first

at the deepest part of the aquifer. Absolute dating operates at the chemical level, based on measuring concentrations of certain isotopes - most commonly tritium (a radioactive isotope of hydrogen) and C-14 (a radioactive isotope of carbon) - and comparing those measurements to known concentrations at particular points in the geologic past. Tritium was introduced by the discharge of atomic weapons, and so the absence of tritium indicates groundwater that was already in the earth's sub-surface at least 70 years ago. But, absolute dating based on measuring radioactive isotopes becomes relative, something like "older than atomic weapons, but younger than a Pleistocene-era geological formation." Charlie, a retired hydrogeologist and favorite local water expert, explains it this way. "If you want to tell the difference between water that's more than 70 years old, and water that was refreshed during the last mini Ice Age, it comes down to Carbon-14." He continues, now reading from a USGS report on the Smoketree Springs Groundwater Basin, "C-14 is produced by the interaction between carbon rays and nitrogen gas in the atmosphere, and it has a half life of about 5,730 years. The C-14 age is calculated on the basis of the decrease in C-14 activity as a result of radioactive decay since groundwater recharge, relative to an assumed initial C-14 concentration." Looking up, he shrugs before continuing, "But, it's not real accurate. There's an error of 20% for calculated ages of groundwater, and they didn't correct for sources of carbon from the sedimentary rocks around the basin. But, the mean figure is 7,000 years old for water in Smoketree."

The difference between fossil groundwater and "younger" groundwater is made meaningful by water modeling practices that divide short-term renewable systems from longer-term, functionally non-renewable ones. As Charlie puts it, "if you are processing and drinking water that was recharged in the last five, six, seven years, that means we have a renewable

system. That system is getting recharge that is going in to the ground, that you then can use to drink. It's like the Mississippi River: the water flows downhill, you drink it by tonight. But, if you are drinking water that is thousands of years old, just think about what it implies. It implies that you're not using any recent water, you're drinking water that literally was probably recharged in the last Ice Age. It is significant because this is not water that is being recharged now, this is a very old basin. I try to use that specifically as a reference, 'look, guys, we have a problem!' If you go to any area that's in balance, you're not going to be pumping fossil water. That's against the definition [of balance]."

Despite its suggestion of scientific objectivity, fossil water is more of a loose, relativist explanatory model than an absolute one. When Charlie calls the Smoketree aquifer fossil water, he's leaning on the scientific authority and "gee whiz!" (his words) significance produced through fossil dating. Using the term fossil water indicates the degree of severity of the problem, and signals the symbolic and material distance from a renewable, sustainable water system. Groundwater is managed top-down, in terms of extraction and overdraft. As long as the water levels continue dropping, the exact age of fossil water isn't actually relevant to the everyday practices of managing and sustaining it. On the other hand, Charlie seems to view the entire world through a geologist's pragmatic and relativistic cosmology. When I ask him about the collection of geodes and local fossil specimens that fills his home, he jokes, "Fossil collection? What fossil collection? All I have are things that are older than me!"

Fossil Water as Fossil Fuel

While in Smoketree, fossil water is narrativized and modeled (at least conceptually) like a paleontological specimen, in Mesquite, an isolated census-designated place of about 150 residents nestled up against the Nevada border, fossil fuels seem a more apt geological comparison. Mesquite's residents are overwhelmingly white and older, retired or semi-retired, having relocated to the desert for the quiet, the relatively low cost of living, or both (U.S. Census Bureau 2015). Although Mesquite possesses more than a few significant geological features of its own - most notably, fossiliferous badlands and a system of natural mineral hot springs that feed wetland habitats - local water discourse instead reaches for comparisons with the town's railroad and mining history. Prior to its founding in 1875, Mesquite served as a stopover point on the Old Spanish Trail along the Amargosa River, with its contemporary location developed in 1907 along the Tonopah and Tidewater Railroad (which connected eastern California to southwestern Nevada, and was used primarily to transport borax). Mesquite's early history also saw the development of several silver and nitrate salt mines that remained in production from the 1860s through the 1950s, following the boom and bust cycle common across the Mojave.

Today, Mesquite's mining and railroad history is proudly preserved by a local historical society, and abandoned mines and miner's living quarters are popular (if often remote and sometimes dangerous) tourist sites. At the same time, the town itself, like many outposts in this stretch of desert, feels like a place perpetually at risk of being abandoned. The population has aged and dropped significantly over the years as the mining industry collapsed, and structural upkeep is a challenge in this environment; the further you travel from the center of town, the

more difficult it becomes to identify which of the cabins and motorhomes are still inhabited, and which have been left to bake in the sun.

A Mining Mentality

Jack, a local farmer and conservationist, is part of an informal coalition of environmentalists and small business owners working to build a tourist economy around Mesquite's historical collections, outdoor attractions, and healing hot springs. His family-owned date palm farm is built at the base of a canyon deep in Mesquite's badlands, on the site of a ranch developed by a local miner in the late 1800s, and later planted with date palms during the 1920s (part of a larger movement of aggressive date palm cultivation and related fetishization of a Middle East-inspired desert agricultural lifestyle in southern California) (Nabham 2008). Today, Jack promotes his ranch as both a working farm, and an irreplaceable cultural and natural resource: his property and resources help preserve Mesquite's unique geological and cultural history, the ranch's oasis ecosystem allows for palm production and serves as a watering hole for migratory birds, and his successful business provides local jobs and attracts ecotourists en route to Death Valley National Park.

Jack sees Mesquite's rapid groundwater depletion as a cultural and political problem, one steeped in certain locals' desires to reenact the town's mining and railroad boom in the late 19th and early 20th centuries. It's a touchy subject for locals (as water in the desert so often is), and it takes some effort for me to reassure Jack that I'm on the same side as him and our mutual friends on the local conservancy board; even so, throughout my visit to the ranch, he is careful to separate himself and other environmentally-minded family farmers from the wasteful water

pumpers who don't care about long-term consequences. "People out here have a water mining mentality," he explains, "They take, and they don't think long-term. We're all living on fossil water out here, and soon all those wet spots [the marshes] will be gone. The water took *millennia* to put down, and we're pumping it out in decades. It sounds pretty grim for the longterm future of places like this." He tells me about his and others' efforts to develop new stories for Mesquite, ones that don't revolve around irresponsible resource extraction, because they already know how those stories end. "Think about all those ghost towns in Nevada, where they exhausted their natural resources and moved on. Imagine if we exhausted all the water. Once it's gone, it's gone."

What does it mean to mine water? Jack uses the idea of fossil water to illustrate groundwater's functional limits and high value. More specifically, his evocation of the mining mentality brings fossil water into alignment with fossil fuel (an ancient resource extracted from the ground, which can only be replenished on a geological time scale), in the context of the American West's environmental history (where foolhardy settlers treated natural resources as though they were functionally infinite, at least until proven otherwise). As with fossil fuels, this iteration of fossil water flattens water use into a simplified linear timeline of resource extraction. Unlike oil or coal, however, the qualities that make fossil water special manifest temporally, not materially; fossil water was deposited in a particular place a long time ago, but its material properties haven't changed. There's an implied rarity and finality in this comparison as well, where both fossil fuels and fossil water can only be created and preserved under a very specific set of historical circumstances, which are out of step with contemporary ways of life. Once the

water is gone, Mesquite becomes a ghost town, save for the residents who, unlike Jack, can't afford to pack up and move on.

The comparison of fossil water with fossil fuels also raises another dimension of resource finality: competition. This is particularly salient in Mesquite, where municipal-scale water issues are compounded by the town's proximity to the Nevada state line, and the difficult reality that groundwater is managed at and by states, regardless of whether the water source in question follows state boundaries. Ray, the young director of Mesquite's local conservancy, is particularly concerned about this point. We met at a Sierra Club Desert Committee Meeting, and bonded by talking about the shortcomings of California's then-imminent Sustainable Groundwater Management Act; from Ray's perspective, the problem is that SGMA assumes there isn't a way to "cheat" in the competition for limited water resources, and doesn't give water managers ways to prevent bad behavior.

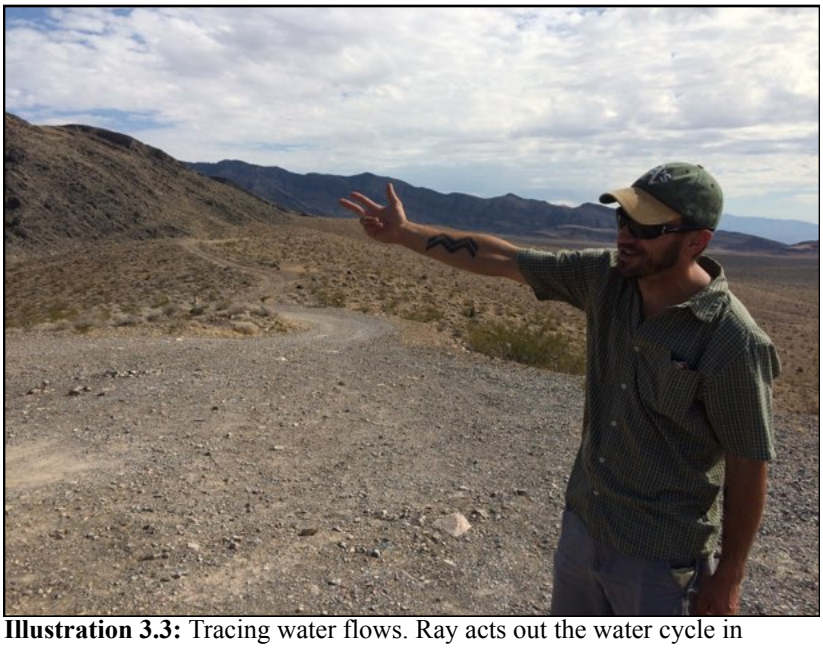

Illustration 3.3: Tracing water flows. Ray acts out the water cycle in Mesquite, where rain flows from the mountains at the left, down in to the valley behind him.

Months later, he drives us to a highpoint of the watershed that encompasses Mesquite to demonstrate a point about the local water cycle. Their aquifer lies below the state line, he explains, with Mesquite and a handful of protected wilderness areas on the California side, and a significantly larger city of "renegade cowboy libertarians" (Ray's

words) on the Nevada side. Pointing to and tracing the water flows in the desert landscape below us, he explains that the aquifer is recharged by rain coming down the tall mountains that frame Mesquite to the north and west, only to be stolen from the other side of the aquifer (and the state line) by the Nevadans. We retrace the route in Ray's truck, driving through the libertarian city (he notes with a scowl that he does sometimes cross the line to buy cigarettes with a lower tax), and then back to the wetlands protected by Mesquite's passionate local environmentalists. He's not sure how long the aquifer actually takes to recharge, but he does echo Jack's characterization of Nevada ghost towns: "the gold rush is still going on over there!" As I would later learn, Mesquite's history does indeed keep repeating: another ongoing water controversy in the region involves investors attempting to purchase and use old railroad right-of-way regulations (where new property building follows the old railroad routes) to pump groundwater for sale to thirsty towns elsewhere.

Sustaining Extraction

This iteration of fossil water as fossil fuel can be found also in the ways that water resource practitioners talk about groundwater management, which was, until recently, so controversial in certain Western states that some joked it may as well be a four letter word. Like other extractive industries, groundwater sparks fierce debates and carefully chosen rhetoric at trade conferences. As one field geologist explained to me, following an uncomfortable Q&A on groundwater sustainability that had us both raising our eyebrows, albeit for different reasons: "Groundwater is more reliable than surface water; I'd tell everyone to use it. The problem is no one wants to admit that, if we're talking about groundwater, we really need to redefine sustainability within

the scope of the project. Sustainability requires us to think about taking water to use now versus saving it for the future. Fossil groundwater is ok, as long as you set up rules." That is, fossil water may have acquired the same symbolic weight as fossil fuels - the same veneer of finitude and wastefulness compared to more immediately renewable options like surface water or solar power - but groundwater is still a practical necessity for many communities in arid and semi-arid climates, where there are no rivers to draw from or oceans to desalinate. Perhaps, with sufficient technocratic intervention, its timeline can still be managed towards something *like* sustainability, at least within the scope of human lifetimes. We might also see in these remarks a subtle critique of the ideal sustainability-as-balance model itself: viewed at scale and in scope, groundwater sustainability is just conservatism.

Interestingly, this highly technical version of the relationship between fossil groundwater and fossil fuels obfuscates a very real technical challenge in groundwater management: as covered in the previous chapter, and unlike oil supplies, the vast majority of groundwater supplies in the United States are incredibly understudied. In any discussion of sustainable groundwater management, scientists and practitioners' most frequently cited roadblock was a lack of knowledge about the water itself. Even more to the point, as JPL hydrologist Jay Famiglietti explained to Smoketree locals during a lecture on groundwater science, the real solution would involve modeling and mapping aquifers the way we do with oil reserves. Given the relative resources behind oil versus water development, though, that's unlikely to happen, and water managers must continue to make decisions with limited information. This is a point where the comparison between fossil water and fossil fuels begins to fall apart: water is and will always be big business in the West, but it's nothing like the political economy of oil.

Fossil Water as Trace

Back at Helen's homestead, she shows me an illustrated guide to the paleontology of the desert region that contains both Smoketree and her hometown of Palo Verde. The book contains colorful panoramas of marine mammals, mammoths, and saber-toothed cats, a desert that is "literally alive with prehistory" (Jefferson and Lindsay 2006, xi).

> Visual documentation in hand, Helen picks up our earlier conversation:
> We're drinking water from the ends of the last Ice Age, when there was a different climate and more moisture. And when you look at the skeletal material at the [paleontology] museum, it was obviously a time when there was much more abundant rain here! You don't have animals of that size without vegetation to support them, and the amount of vegetation that's necessary to support animals of that size is incredible! It would be interesting if any of the geologists had said, this is what we think the rainfall patterns might have been at the time when these large animals were living here, because that's when the water table was built. That's when we were getting recharge to the aquifers here. There had to be a very, very different climatic regime that supported that kind of mega-fauna. And that's what people in these areas need to understand, is that the water in our groundwater basins came from a time when these large animals were living here, when the rainfall was more than anything we can comprehend any place we've ever been.

She wonders whether the geologists in Smoketree have studied this - what the precipitation was like 10,000 years ago. It would be interesting to know, but, more to the point, she'd like to include that scientific information in her next public comment letter to Imperial County, as further evidence that exploitative water users and developers are living out of step with the current reality.

Here, fossil water manifests as a trace of deep time, a means by which to model the strange relations between Helen, Helen's water adversaries, and prehistoric creatures and climatic regimes. Her point is subtle, but undeniable: it's simply unrealistic to expect renewable

groundwater in the modern California desert, as unrealistic as looking out her window to see that valley full of mammoths. Of course, as she later acknowledged, that reference point in water history wasn't completely sustainable either (at the very least, by virtue of its inability to persist).

Traces and Relations

This iteration of fossil water - fossil as trace - is one I heard frequently from geologists and activists alike. Fossil water as trace is echoed in serious discussions of the long-term future of drying up places, like Helen using geological and ecological relationships to link a distant imagined past to her lived present, as well as in desert humor used to evaluate or deflect particular discourse about water management. When Smoketree locals asked me to describe my research, they would often follow up with "you know, this whole place used to be a lake," referring to the Valley's oceanic past. Depending on the speaker, I learned to interpret this response as either a sincere explanation of the region's geological history (and perhaps a way of putting the contemporary water situation in to its "true" context), or wry commentary on the state of local water politics (and particularly at the expense of those who insist water is plentiful based on historical data). Thomas, a particularly cantankerous member of the Smoketree Water District Board, is fond of an even longer temporal joke. During a delicate conversation between the Board and a consulting engineer regarding a local golf resort's private wells, Thomas asked about the resort owner's very public claims that "his" water actually comes from a town on the other side of the mountains. When the engineer tried to be diplomatic ("well…maybe on a long time scale…"), Thomas deployed his favorite snappy comeback to ill-informed statements on groundwater systems: "well, *actually*, all water comes *from a comet*…"

Two points are worth noting here. First, establishing these linkages between contemporary desert dwellers and past forms of life is not a neutral act, just as any curating of history is not a neutral act. In reaching back to geological time, participants in fossil water discourse (who are, in my data at least, largely older, white, middle class professionals) draw themselves into relation with extinct mega-fauna and abiotic forces, while denying the same temporal subjecthood to other past and present occupants of the land, both human and non-human, who are rendered insignificant in this geological cosmology. Similar to much anthropocene discourse, this scaling is intended to highlight just how rapidly humans have permanently altered the geological world, and in ways that past forms of life did not or could not. At the same time, and perhaps out of necessity, it collapses all of human history into the past few decades of large-scale development and agricultural production. Again like anthropocene discourse, this has the unintended consequence of solidifying as scientific fact relations based on colonialism and capitalist production and accumulation (Gibson-Graham 2011; Haraway 2016; Povinelli 2016; Tsing 2015).

Second, and related, invoking this watery model of change over deep time also destabilizes the assumed human reference point for water temporalities in interesting ways. In its enactment, it suggests something like Helmreich's extraterrestrial relativism: a relativism about nature over culture, which may take the form of "a non-anthropocentric relativism in which humans (as well as other creatures, and, at its limits, life itself) may be entirely absent" (2012, 1126-1127). At the same time, the degree to which temporalities of geological materials could truly be considered non-anthropocentric is not always clear. These temporalities are animated by geological language that references the god-like view from nowhere of scientific objectivity (Haraway 1988), but

actually (and often playfully) requires a specifically located human interpreter to make local sense of them.

While shadowing Sam, a long-time backcountry ranger for Smoketree State Park, as he documented water levels in naturally occurring rock depressions (or tinajas), we swept through a popular "primitive" campground at the edge of the badlands. As Sam wandered on foot through the sandy washes that serve as camping spots, he kept his eyes on the ground, surveying the tan, orange, and pink layered rocks at the bottom of the canyon walls, and stopping occasionally to pick up a few larger ones. He shows me the culled rocks before dumping them in the back of his truck - "invasive rocks!" - explaining that the amateur geologists and rock collectors that visit Smoketree at this time of year are often on their way west from a gem and mineral show in Arizona. They collect rocks from the deserts east of Smoketree Valley, but then process them in the campsites here, resulting in rock detritus that is very similar to, but does not "belong" to, our local rock features. Sam is at least partially joking when he calls them invasive - directing his frustration with the rocks' unwelcome mobility at the absent rock collectors more than the rocks themselves - but removes them from the campground nonetheless. I ask why he goes out of his way to do so; rocks aren't alive, and they certainly can't multiply or out-compete native rocks. Why can't they stay where they are? Sam's answer is characteristically sincere: it's his job to protect the park from invasive species, and he doesn't see why he should stop at living materials. Besides, he wants people to see and appreciate the "true" geological history of the Valley, and these rocks aren't part of that preserved history. It's a playful response to a playful question, but also one that reveals an entire ideology of particularly situated protectionism in regards to materials and material history. As with the paleontologists who attend a year's worth of classes to

properly collect and appreciate local fossils, the message is clear. Relationships between humans and geological materials are nurtured through training and careful curating, both of the materials themselves and of the history they belong to. Which raises the question: what does it mean to be written out of (or marked as invasive to) geological history?

Loss and Lasting

During one of my first conversations with Anne, the principal of Smoketree's high school and a fellow anthropologist, she described some of her favorite cultural history sites in town. The DiGiorgios were one of the original agricultural founders when Smoketree was effectively a company town in the early to mid-1900s, and part of their farm land is still visible on the edge of town along a bicycle path. Anne explains that, today, when farmers fallow old fields in the desert, they have certain procedures they have to follow: digging up crops and taking out windbreaks, preparing the soil so that it doesn't dry up and generate dust, and so on. The DiGiorgios didn't do that; they just stopped farming that field. "They just abandoned all the grapes!" she says, "And you can still see all of them out there, all dried up. Everything lasts in the desert."

A few months later in early spring, Matt, the education coordinator for Smoketree's natural history association, invites me to tag along on his favorite midnight hike through one of the few east-west facing canyons in the badlands outside of town. After navigating a steeply pitched road to the edge of a wash heading up the canyon, we pile out of Matt's Jeep and take in our surroundings. The moon has risen fully by this point, and the light bounces off of the high canyon walls, shading the tan rocks with deep grays and browns. The reason Matt likes this trail

at night is because "I look up…and I feel like I'm on *planet earth*. These rocks around us are millions of years old, maybe ten million years. And then we look up. We're not seeing quite as far back in time when we look up - we're not seeing 10 million light years old stars - but we're still seeing long-dead light. It's still old."

The same features that preserve fossils and render geological history visible in Smoketree, Mesquite, and Palo Verde - the aridity, the heat, the isolation - also raise the stakes of human residents' attempts to make their natural resources and lifestyles sustainable. They are surrounded by evidence of a past (or, more accurately, of many different pasts) shaped by an abundance or scarcity of water, which are continually re-read and re-enacted within their own contemporary attempts to make their water-based lifestyles sustainable (Basso 1996). If, as Ogden writes of the anthropocene, "the Earth's stratigraphy tells the story of the temporality of loss in the making of a common world," (Ogden 2016), what does it mean to become a fossilized trace in a place where everything lasts? What does sustainability mean in an environment where extreme attenuation has become normalized?

Conclusion

We could argue that all water everywhere is connected on a large enough time scale. Rachel Carson famously wrote of the interconnectedness of toxic waterscapes, and we've all heard conservation campaigns telling us there is no "new" water on earth, or that everything we drink is dinosaur pee. It is tempting to say that water is both in time and time*less,* but I would instead suggest that, here in the desert at least, water is both biological and geological, biotic and abiotic.

"We're following the water," Don tells me, leading the way deep in to a labyrinth of crumbing rock. He points to the curving, rope-like ripples in the sand beneath our feet, traces of the braided stream that flowed here during the last flash flood a few months ago. We started our journey at the edge of the badlands, parking Ernie's stripped-down Jeep in a flat, sandy wash. That's where the water ends up, he explains, but first it runs down these narrow channels between ridges.

Illustration 3.4: "I found the water!" Ernie, a geologist in Smoketree, joking around about finding and following the water while fossil hunting.

"That reddish rock is probably Colorado crap," says Don, indicating the reddish brown rock layer called the Arroyo Diablo Formation, eroded from the Colorado Plateau about three million years ago. Don's colorblind, though, so he jokes that all he sees is green. We're looking for the Borrego Formation, the slightly younger tan and brown sandstone that holds marine fossils from a prehistoric lake basin. We're walking through a landscape

carved by water, both recent and ancient; this always strikes me as a bit funny, a desert formed by water, now only visible through its traces.

We scamper up and down crumbling ridgelines thirty feet high, following traces of water until they dead end or become impassible. When Don and Ernie were younger, they used to play the game, "find the highest point and walk to it," but now they joke that they play a modified version called, "find the highest point and figure out if it's worth it to walk to it." As Don repeatedly warns me throughout the day, "just because the water got down from there doesn't mean we can!"

Don tells me I should really look into the six or eight water companies on Palomar Mountain, a large wilderness area about an hour west of the Smoketree Valley, off of a major regional highway. They're all drawing groundwater down, he says, and moving it out in tanker trucks all day long; he drives past them on the highway on his way home from Smoketree. He's heard about the drought being the worst on record, but the recorded history is only 200 years long. It's a drop in the bucket. "It's not drought," he says, "it's just change." Don is a retired wildlands fire captain; he's fought fires in forests all over the western states for decades. "The forests are dying, and it's not because of our strategies," he says, "it's because of change. Maybe they're ready to be something else."

We could certainly take Don's comments as a refusal or depoliticization of drought and climate change, but I see something relativist and post-human in them as well. At stake in these models of water temporality is not only how Californians engage water management practices in specific communities, but ultimately how humans in general live with water that exists on a geological timescale, where living and non-living things move in and out of a chemical and

physical system that exceeds our grasp. From that perspective, Don has one of the longest views on water and climate change I've encountered: Maybe it's just change. Maybe this place is ready to be something else.

FALL: PETRICHOR

On one of my first trips out to the desert, I stood outside of the field station with Travis, the ecologist who serves as the station's faculty director. The sky had been grey and cloudy all morning; a rarity for a place made of endless blue skies that served more to amplify the sun's rays than refract them. Travis, I have learned, is prone to broad scientific musings about the nature of the world that sometimes border on the metaphysical: the first time we met, he wandered aloud what had made the first multicellular organism bond with another multicellular organism to increase their fitness. His enthusiasm for the biggest of the big questions is infectious.

As we talk about the field station nearing the end of its renovations and opening its doors to a new cohort of desert scientists, a soft rain begins to fall. I watch the drops strike the sand beneath our feet, turning it a deeper shade of tan as the water saturates the parched ground. Travis smiles in to the rain, telling me that rain in the desert is like a sunny day in the Pacific Northwest: "everyone wants to go outside!" He tells me about a book by an ethnobotanist, who worked with the Tohono Odham Indians in southern Arizona, *The Desert Smells Like Rain.* "It's the petrichor from the creosote," he explains, "Creosote releases oils in response to moisture in the air. You can smell it if you breathe on the leaves of the plant, too. It smells just like rain hitting the asphalt. That's why the desert smells like rain!"

I try this many times over the next year, cupping a creosote branch full of small, stiff leaves in my hands and breathing hot air on them like I'm cleaning my glasses. Each time, the snap of ozone drifts up to my nose.

I learn to recognize this smell instantly. In the desert, you can smell rain before you see or feel it. In the fall monsoon season, the petrichor will waft by your nose, carried along by the sharp winds whipping down the canyons to the valley floor, unimpeded by buildings or vegetation. The sky darkens and the rain falls, delicate at first, then picking up strength as the storm moves overhead. You can watch it move for miles, the rain shadows slicing through the desert light as they slowly saturate the valley. Of course, you may have no choice but to stop what you're doing and watch the rain instead. Downed phone lines and power outages are common whenever there's water in the desert. Residents often don't even bother contacting the utility company, they just assume they'll figure it out when they see the weather report.

The exception, of course, is a flash flood, which you will generally hear before you see it, particularly if you happen to be at the mouth of a canyon. Nearly everyone I talk to has a story about floods: running or driving away from them, photographing them, getting stuck on the wrong side of the highway that connects their town to its neighbors because of them. The trouble with floods is that they don't work the way you think they should in the desert, at least not always. Sometimes, a small vein of a river will overflow gradually over a span of rainy days, like the Amargosa River did last fall when Ray, the head of a local conservation group, paddled a kayak through it just outside of Death Valley National Park. More often, though, floods feel like an effect disconnected both temporally and spatially from its cause; a building torrent of water from a rain storm that may have happened miles away and hours or even days ago.

Like all water in the desert, rain does not behave the way we think it ought to. Instead, we're left to anticipate and respond, molding our lives around the particular patterns and extremes that can only be understood fully through direct experience. In times of drought,

waiting on water takes on a different urgency. The “ridiculously resilient ridge,” the absurdly-named region of atmospheric high pressure in the Pacific Ocean that consistently redirected wet storms away from California in 2013-2015, inspired anger and dark humor in equal measures.

Months later, Travis mentions creosote again as he explains his (apparently rather controversial) argument that shrubs are the only “true” desert plants adapted to the extreme climate. Desert plants, by nature, must be both sensitive and ruthless; responding instantly to take advantage of any increase in water. He wonders aloud whether humans that live in the desert can be classified like plants, according to their adaptations. Who responds best and most quickly to the possibilities afforded by water? Who can tell when it’s coming and what to do? “Who here is an ocotillo?”

CHAPTER 3: NUMBER NARRATIVES

Introduction[9]

Like much of the American Southwest, the small desert town of Smoketree, California has a perpetual water shortage, and that shortage is expressed through a combination of numbers and words. Throughout my fieldwork with local environmental experts and activists, most of my conversations included the other person asking if I had heard "the story of the overdraft." The story is this: In 1982, a United States Geological Survey (USGS) report produced scientifically derived, "definitive" evidence that annual withdrawals from the Smoketree Springs Valley Groundwater Basin—the community's sole source of water—exceeded natural recharge to such an extreme numerical degree that serious economic, social, and environmental threats were likely to occur within 50 years (Moyle 1982). In other words, this is a story about the moment in which quantities of human extraction outstrip quantities of available water over a particular number of years.

In the several decades since that report, the story continues, over five million dollars of technical studies have been conducted to more accurately calculate the physical dynamics of the aquifer, and to model options for increasing the total amount of water available. In that same time period, however, overall water consumption rates have more than doubled, and the community as a whole can barely agree that the shortage exists at all, much less how to forestall it. Local scientists and water managers became frustrated: how had what appeared to be an easily

[9] A version of this chapter was previously published as "Number Narratives: Abundance, Scarcity, and Sustainability in a California Water World" in *Science as Culture,* Volume 26, Issue 1. The original article is available at http://dx.doi.org/10.1080/09505431.2016.1223111.

quantified and understood problem—balancing numbers in with numbers out—generated so much uncertainty, inaction, and distrust?

This story was repeated to me so frequently and so consistently that I began to think of it as a piece of folklore endemic to the envirotechnical regime of California water management. Different people might debate or modify small details, but the basic themes (and the charismatic round number 50) remained. Characterizing water quantitatively as a diminishing resource with a specific number of years left is a familiar technological narrative in the American Southwest; operationalizing water across both time and space, while presuming a world in which that water is already known to be scarce. In Marc Reisner's words, "The [Western] states knew the groundwater couldn't last forever . . . they had to decide how long to *make it last*" (1993 [1986], 10, emphasis mine). As a numerically driven narrative, then, "50 years of water" circulates in Smoketree as both a local explanatory model, and a broader cultural imaginary about groundwater in California.

How do numbers become the primary narrative frame for understanding what an environmental problem is, what it has been, and what it could (or should) become? What does it mean for particular individuals or groups to choose between, adopt, reject, or favor these numerical stories? Quantification alone—the production and manipulation of numbers—does not explain how these numbers figure in social interactions about water. By attending instead to this normative practice of positioning numbers in stories, I argue for the importance of what I call number narratives: numerical stories about how an environmental object works in a particular place and time. These number narratives are imaginaries, revealing moments where numbers become not only assertions of transparency, trust, or objectivity, but also literary and social

technologies (Shapin and Schaffer 1985) for holding particular "waterworlds" (Hastrup 2014) of people, places, things, and practices together. Here in Smoketree, number narratives make groundwater—a substance that is, by its very materiality, unseen, uncontainable, and unpredictable—seem visible, bounded, and manipulable. Their narrative form communicates and shapes discussion over critical issues of water abundance, water scarcity, and water sustainability. Ultimately, Smoketree's water problem is not about numbers at all, but about old tensions, uncertain technological and political futures, and the potential failure of everything that can't be quantified.

Methods and Outline

It is tempting to assume that water in California has always already been political; but, I wish to start instead from Samer Alatout's assertion that, "For water to become political, it has to be made political . . . to be enrolled in the service of one or another technopolitical network" (2009, 371). My goal, then, is to explore number narratives as an entry point for considering how Smoketree's water became enrolled in particular environmental and technological politics for particular reasons. If what we consider nature does not exist independent of our attempts to know it, then what (and whose) nature(s) do these numbers envision, elide, or enact?

I begin by reviewing analytical perspectives on numbers and water from anthropology, environmental history, and science and technology studies. I am interested here in drawing out how quantification—and specifically, the attaching of a number and an attendant narrative to a local environmental problem—works within watery envirotechnical regimes as an articulatory

practice between science, technology, policy, and discourse (Alatout 2009). Next, I provide background information on relations between the micro or local-scale of Smoketree Springs Valley and the mezzo scale of California water politics. Building on this foundation, I examine three number narratives: (1) 500 years of water, the historical promise of an abundant, functionally infinite supply of water; (2) 50 years of water, the contemporary narrative of scarcity that framed local water as a finite resource; and (3) Sustainability = zero, the new goal of solving groundwater shortages through balance. I discuss each number narrative on its own terms —its emergence, significance, and the story it purports to tell—as well as its reception, circulation, acceptance, or rejection by different individuals and groups. While "the story of the overdraft" suggests a historical progression where increasingly accurate numbers are attached to nature, I am interested instead in highlighting the dynamic tension between these number narratives and nature, and between the number narratives themselves.

Analytical Frameworks

Combined, these number narratives demonstrate how the residents of Smoketree imagine and live with a water problem that exceeds their numerical grasp. At stake is not whether these numbers are accurate to the water problem at hand, but rather what these number narratives afford in terms of possible worlds for the town and its residents. The idea of number narratives is not just an appeal for ethnographic attention to the production of specific numbers and "centres of calculation" (Latour 1987), but a broader call to take seriously how stories with numbers come about and circulate, with the same numbers used over and over to create a sense of history, context, and shared meaning. In other words, regardless of whether the number 50 is accurate or

true to the water problem at hand, what does it mean for particular individuals or groups to adopt, repeat, or reject the number narrative encoded in "50 years of water" across time and in different social spaces?

To analyze these watery number narratives in practice, I call upon analytical perspectives from science and technology studies and environmental anthropology to link three concepts: formalizing practices, narrative frames, and envirotechnical systems. Brought together under the umbrella of the number narrative, these concepts help elucidate how numbers about water gain authority and traction; how competing numerical stories frame problems, solutions, and entire ways of life; and how number narratives work as articulatory practices that help enact particular environmental, technological, and political systems.

Numbers as Formalizing Practices

Science and technology studies offers many perspectives on formalizing practices (such as quantification) in general, and on numbers in particular. Numbers figure in an "American imaginary of countability" (Bowker and Starr 2001). They are a form of distancing that allows for an appearance of neutrality, objectivity, or credibility (Porter 1992; Lampland 2010); for the production of public authority or non-authority (Asdal 2011); for the creation of divisions between "real" and "virtual" resources (Barnes 2013); or for the abstraction and translation of value (Maurer 2006). Emphasizing the "doing" of numbers further reveals that numbers do not exist "out there" in nature waiting to be found, but rather are produced by and grounded in specific knowledge-making practices and political actions. The ways in which their supposed accuracy, objectivity, or trustworthiness are activated result not from their veracity, but from

particular values (e.g. the "openness" or transparency of bureaucratic regimes) and social practices. Inversely, then, debates and controversies over the production of specific numbers are debates about those values and practices as well.

Numbers also do not travel alone. Communication and circulation of these numbers-as-facts utilize "literary technologies" that enroll "virtual witnesses" in the practices of numerical production, as well as "social technologies" that shape how those numbers are to be reckoned, by whom, and in what spaces (Shapin and Schaffer 1985). As we shall see, virtual witnessing also requires "a technology of trust and assurance that the things had been done and done in the way claimed" (Shapin and Schaffer 1985, 60). Attending to this politics of trust—how individuals accept, reject, and debate particular numbers—thus requires a focus on these literary and social technologies as well.

Narratives and Frames

In the context of water problems, I argue that numbers work as numerical stories, with features similar to Arthur Kleinman's illness narratives (1988) and Kevin Armitage's technological frames (2013). Number narratives reflect the authority of the numerical practices that produced them, but also simplify and make numerical sense of relations between people, places, things, and practices in particular water worlds. They are numerical stories about how water works in a given place and time, but also an entry point in to the environmental, technological, and social politics—the literary and social technologies—of that place and time. Like illness narratives, number narratives place numbers within a locally meaningful context of familiar objects and understandable material practices (Kleinman 1988). Environmental

processes, like biological ones, "are known only through socially constructed categories" that organize our common sense understanding of them (Kleinman 1988, 17). As literary technology, the narrative mode gives form and voice to lived experience and messy material reality; as social technology, it allows for discussion of particular events and objects. In their circulation, adoption, and rejection, number narratives also indicate aspects which escape the number's grasp: the phenomenologically huge, the experientially small, and the unknown and unexpected.

Like technological frames, number narratives do not suggest a progressive timeline in which people gradually apprehend the "true" numbers, but rather a world of competing explanatory models used to interpret events that inevitably escape the number's grasp. "Framing tasks" develop a diagnosis and prognosis for collective advocacy in response to environmental problems, but technological frames only succeed if their users believe that they resonate with lived reality (Armitage 2013). Number narratives determine the genre and parameters for both the problem and the solution, but they're ultimately beholden to the material reality they seek to contain. Like technological frames, multiple number narratives can compete or co-exist. Number narratives can become meaningless or even erased, just as numbers themselves can become outdated.

Envirotechnical Systems

By focusing on numbers as narratives, and contextualizing them within their environmental, technological, and political systems, the discursive power of particular, specific environmental numbers are further revealed. Through their enactment, numerical practices like number narratives make environmental objects thinkable and knowable in particular ways,

generating “an aura of objectivity for phenomena that are taken as real only after their very counting has occurred” (Ballestero 2014, 39). Number narratives give form, boundaries, scope, and scale to an amorphous object’s forms and relations with humans. Once made real, nature can then be brought under the jurisdiction of those same numerical practices; as Kristin Asdal writes on pollution metrics, “Without a budget, nature could not be monitored, and thus made real, visible and known – in the sense scientists, administrators and politicians were after” (2008, 127). At stake in the production, circulation, and interaction between various number narratives are larger questions about how environmental objects like water should work, and what forms of life they should support.

Made real, known, and governable in this way, water, in Ben Orlove and Steven Caton’s words, operates as a “total social fact” (2010, 402). As a result, studies of water within science and technology studies have sought to view it not as a cleanly bounded natural object, but instead as a complex network of waterbased social, political, technological, and environmental relations between human and non-human agents (Bakker 2012; Barnes 2012; Carroll 2012; Merchant 1989; Mukerji 2009). Moments when water becomes a matter of concern reveal the irreducible materiality of non-human nature, those qualities and forces of water that push back against quantification, reduction, and best laid plans. In this formation, a body of water does not have an envirotechnical system; it is an envirotechnical system (or more accurately, it is many envirotechnical systems across many points in time) (Pritchard 2011).

Numerical practices thus help bring watery “envirotechnical regimes” into being (Pritchard 2011). The problem of managing water can shape the scope and scale of a state’s political, economic, and technoscientific governance, particularly in cases of conflict (Alatout 2009;

Espeland 1998). The tricky materiality of water's flow drives the formation of regimes specific to the complexities of rivers, watersheds, and dams (Barnes 2012; Caroll 2012), and shapes the forms of expertise that can be brought to bear on water problems (Jørgensen 2013). Numerically driven narratives about how water works can erase acts of labor by humans and water alike (Barnes 2013), and hold together entire discursive "networks of erasure" that preclude the possibility of imagining water otherwise (Alatout 2009). This erasure can even extend to analytics of water. For example, Alatout critiques the assumption that resource scarcity acts as "a threatening condition that underwrites almost every environmental conflict," despite cases where water abundance has similarly been politicized as a "strategic resource for managing relations of power and conflict" (2009, 383). In this sense, attention to number narratives provides a reminder of how taken-for granted valuations of quantity and quality can smuggle in entire political projects.

Watery History

Like much of California, Smoketree has become enmeshed in an envirotechnical regime of groundwater surveillance, drought mitigation, regulatory science, and climate change adaptation. In this context, Smoketree's water shortage is specifically constituted as a groundwater overdraft; a large-scale, long-term event coproduced by humans, water, and technology, and apprehended through a number narrative that compresses that event in to an expiration date. The end result of this enmeshment of local and regional technopolitics is the ability of Smoketree's number narratives to "speak" (Ballestero 2014) as both specific to their individual context and representative of trends within California or the American Southwest more broadly.

Smoketree sits on the western edge of the Sonoran Desert, approximately 100 miles inland, with most of its 3,500 year-round residents clustered around a central business district. While U.S. Census Bureau data records Smoketree's population as 80% White and nearly 36% Hispanic or Latino (2010), with a median household income of approximately $42,000 (2013), local community leaders are quick to note that these numbers do not accurately capture their reality. Instead, they suggest that the percentage of Hispanic or Latino residents is likely higher, and the average income likely lower.

Although technically within populous San Diego County, Smoketree is defined by its geographical, political, and hydrological isolation. It is an unincorporated town, with the statistical delineation of "census-designated place". The greater Smoketree Springs Valley includes roughly 4,000 acres of agricultural land managed by family farms and distant agribusinesses; a small, low-income recreational vehicle community; and a handful of isolated "off the grid" homesteads. Mountainous Smoketree Springs Park, a large desert wilderness area administered by public lands agencies, borders the Valley. The most powerful local organizations in water management—the Park, the Water District, the Agricultural Association, the Chamber of Commerce, and the Water Stakeholders' Coalition—share overlapping members, while maintaining the expected tensions between competing agendas to promote tourism growth, sustain agriculture, or protect wilderness areas. These tensions emerged in practice as individuals configured themselves and their organizational affiliations in debates over how water should be used: to water golf courses, to preserve landscaping or agriculture, to maintain the health of ecosystems, and so on.

The stakes of these debates are high. Smoketree Springs does not take its water from the Colorado River pipeline, nor does it store water for any entity outside its boundaries; instead, it is entirely dependent on a locally managed groundwater system. This functional water independence makes Smoketree something of an anomaly within California, and shapes how local number narratives interface with (and where they deviate from) broader understandings of how water can or should be manipulated (and by whom) in the American West. A presumption of environmental exceptionality has shaped Smoketree Springs in one way or another for over one hundred years. Smoketree Springs Valley was known to cattle ranchers as a water source by the late 1800s, with homesteaders beginning to settle the broader region in 1910 (Brigandi 2001). The desert agricultural boom of the early 1900s—driven in California by intensive irrigation near the Mexican border—eventually expanded to encompass Smoketree (Hundley 2001). Beginning in the 1920s, peaking shortly after World War II, and continuing to the present day, the comparatively large groundwater supply supported farmers growing crops like citrus, alfalfa, and dates.

During the 1930s and 40s, conservationists began acquiring federal land in the region, eventually preserving nearly 600,000 acres of desert wilderness (Lindsay 2001). While agriculture remained the economic driver of the Valley through the midcentury, developers in the 1940s began envisioning a built desert oasis sustained by Smoketree's supposedly endless water supply. Resorts with golf courses and swimming pools attracted crowds of seasonal visitors. Commercial and residential development continued to grow steadily through the midcentury era and beyond, weathering California's plummeting land values in the 1970s and the national recession in 2007 to 2009. Today, Smoketree's economy relies heavily on tourism and a seasonal

"snowbird" population, whether they come for the wilderness or the golf courses, and residents take pride in local lifeways made possible by this watery history. Narratives about water are thus, quite directly, narratives about locally specific forms of social, political, and economic life, both past and present.

Contemporary Water Politics

2014 saw two significant, interrelated events in California groundwater management, each driven by a quantitative problematization of water as a scarce resource, and each affecting Smoketree in profound ways. As we will see, debates over number narratives in Smoketree are frequently debates over the town's place within this broader envirotechnical regime, the significance of that place for particular individuals and agendas, and the presumed fixity of its groundwater numbers.

First, one of the worst droughts in the state's recorded history continued to escalate. The National Drought Mitigation Center reported more than half of California faced conditions of "exceptional drought," a category indicating "shortages of water in reservoirs, streams and wells creating water emergencies" (National Drought Mitigation Center 2014). The "water emergency" designation was echoed in emergency reduction ordinances from the state legislature, in drought mitigation planning from state regulatory and scientific agencies, and in mandatory conservation measures across local water agencies.

Second, Governor Jerry Brown signed the Sustainable Groundwater Management Act (or SGMA), which imposed state-level regulation of California's notoriously (and, many claimed, dangerously) under-managed groundwater supply. The SGMA would not, strictly speaking,

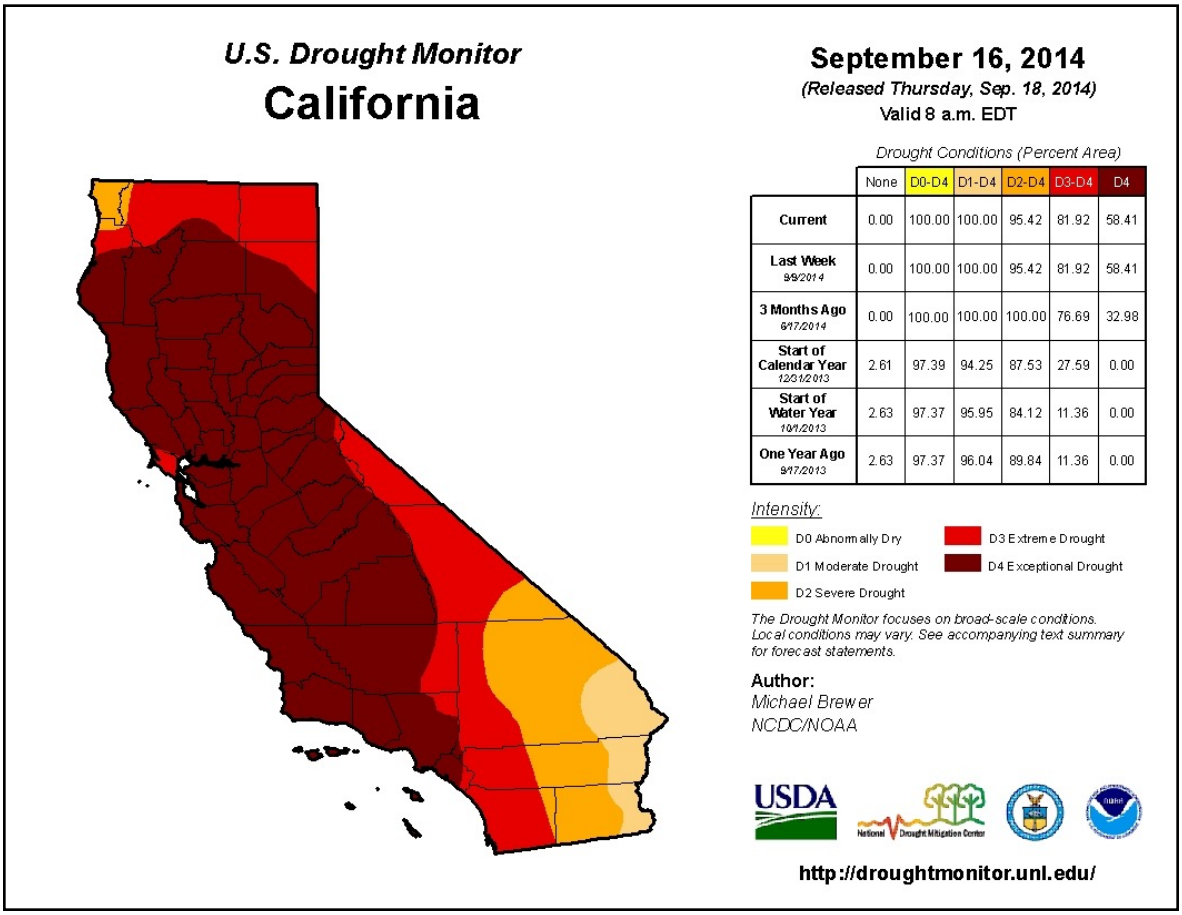

Illustration 3.1: The U.S. Drought Monitor's map of California drought conditions for the week of 16 September 2014. This map was released two days after Governor Brown signed the SGMA legislative package in to law.

Source: Map courtesy of NDMC-UNL.
Note: The U.S. Drought Monitor is jointly produced by the National Drought Mitigation Center at the University of Nebraska-Lincoln, the United States Department of Agriculture, and the National Oceanic and Atmospheric Administration.

centralize groundwater management at the state level. Instead, it required local water agencies to adhere to statewide timelines and priority designations for groundwater basins, and to develop Groundwater Sustainability Plans in accordance with state-determined standards.

Thus enrolled in California's water emergency, groundwater was defined within a narrative where Californians had reached a quantitatively determined threshold moment, and would have to dramatically shift the ways in which they understood and consumed water. While the available

quantity of surface water could, theoretically, increase with precipitation, desalination, or importation, groundwater was instead discursively framed as a specific, localized, nonrenewable resource pumped from the ground like oil. Once determined, groundwater's numbers seemed fixed. In Smoketree Springs, locals were faced with a two-part problem: first, how to relate their smaller, familiar number narratives to this large-scale threshold moment narrative; and second, how (or whether) they could reconcile the two.

Abundance: 500 Years of Water

The disparate water visions and transformations that shaped Smoketree's early history may seem incompatible, but they are animated by a shared number narrative: "500 years of water," the claim of abundance that drove development in the Smoketree Springs Valley through the 1980s. While contemporary discourse on the 500 years narrative often centers on whether the number itself is (or was) right or wrong, it also reveals the ways in which Smoketree itself has shaped and been shaped by a narrative of endless water. Grounded in debates over diagnoses of Smoketree's water problem, and placed in relation to the formalizing practices that shape contemporary water management, the "500 years" number narrative operates as something like a broken promise (to business owners and farmers), an outdated fact (to technical consultants), or a willful misunderstanding (to water managers and advocates) that is somehow incompatible with the real water supply "out there".

In practice, 500 years of water was often framed as a founding fable of the "old" Smoketree, defined by its exceptionality within the California desert. John, a local farm owner, relayed his version: "Our farm was established in the late 1950s; we started pumping water

before the Smoketree Water District was even born! At that time, we were looking at 500 years of water. We would be sustained with an endless supply of water." Two points are worth making in regards to John's iteration of the number narrative, which is shared by many longtime residents and business owners. First, his emphasis on the narrative trajectory of Smoketree's water management: some water users were here before others, and some water users lived through older number narratives than others. In the context of California's notoriously complex water rights system—a key feature of its watery envirotechnical regime—an informal claim to being a "senior water user" inevitably indexes the "first in time, first in right" prioritization system (Hundley 2001), whether or not that system is actually being activated. John notes that 500 years of water is an outdated number narrative, and one that he no longer believes to be true; instead, his story relates how he was here at a moment when it was still thought to be true. In so doing, he links past and present number narratives in a progression of historical time, while also using the older number narrative to advocate for agriculture in the present.

Second, the interesting slippage between "500 years" and "endless," a rhetorical move that echoes the larger "fable of abundance" within the environmental history of the Western United States, where natural resources such as land and water are constituted as eternal (Lears 1994), at least until proven otherwise. Here, the simplicity and breadth of the number 500 allow it to contain the historical values of abundance and "beneficial use" that shape the late nineteenth and early to mid-twentieth century politicization of California water; to afford an entire world where water was plentifully available for those who could build and green the desert (Merchant 1998; Hundley 2001). Indeed, I frequently heard interviewees collapse "unlimited supply of water" and

"500 years of water" into the same number narrative, making the point that they were (and perhaps still are) considered functionally interchangeable.

Why 500 Years of Water?

If most people today acknowledge that 500 years of water is an inaccurate number narrative, then why does it still emerge so frequently in local discourse? Some water activists and local leaders, especially those with technical backgrounds, speculated as to whether "500 years" was the first scientifically derived number attached to the water source, and perhaps the authority produced by those early quantitative practices explains why the narrative continues to be a sticking point for those seeking to justify their claims to water.

Considering models from USGS and surveys done by the California Department of Water Resources (DWR), there are over 60 years of quantitative analyses suggesting that Smoketree residents pump out more water every year than is replenished. Yet, to assume that the narrative of "500 years of water" (or, indeed, any narrative) emerged unambiguously from this pile of data speaks more to the ability of numbers to stand in as constitutive of facts; as objective signs that can travel free of context and value (Porter 1992; Ballestero 2014). Thomas, a local public official with a background in land use planning, relates a version of the narrative that illustrates this point: "The '500 years' number came from a DWR representative, who took the three million acre-feet of remaining water stored in the basin, and the 6,000 acre-feet per year overdraft, divided those two things, and said, 'Ahha! There's 500 years of water left in the basin!'" This number was then removed from its context and caveats—the most egregious omission being that the original calculation did not factor in continued agricultural use—and

reported as more definitive than it actually was. Five-hundred years, according to Thomas, is not so much a scientific fact as it is a faulty secondhand projection, which just happens to be simple enough for a non-expert to visualize, and rational enough to be resistant to change. "Anybody who understands hydrology, who understands how those numbers work and where they come from, knows you don't do that," he explains.

In rejecting the 500 years of water number narrative, Thomas and others point to the central tension in a water world shaped by it: how can Smoketree's groundwater contain both a fixed quantity of water and the fluid quality of abundance? Interestingly, these dual possibilities are also afforded by the material qualities of the aquifer itself. Groundwater is, by definition, underground, unseen, and impossible to measure completely, and so the use of round numbers like 500 helps to bound and manipulate it. Below the ground, the formalizing practices that produce precision through direct measurements begin to break down. The geological explanatory model used by local water experts becomes more complex: the Smoketree basin is not level, but tilted; it's composed of gravel and fractured rocks, with smaller-sized materials at greater depths. Geologists further split the aquifer in to three "parts" corresponding to composition and depth: the upper, middle, and lower aquifers. The true size and dimensions of the total aquifer system are unknown, and so any number corresponding to years of water left is not a measurement of remaining capacity so much as an estimation based on how water use and water levels have changed over a period of time for which there is reliable data.

As a number narrative, 500 years of water made the aquifer real and imaginable as an object scientifically proven to exist at a large scale, and constituted it within the quantifiable "governable space" of natural resources (Asdal 2011), while also rendering it unthinkable as

something that could diminish within any one individual's lifetime. In its continued circulation, it speaks to the ways in which Smoketree's historical narrative of exceptional water abundance continues to stretch in to the present and the future, not yet erased by the narrative of water scarcity that dominates elsewhere in California. "Somehow, people are still surprised," says Martin, a Water District supervisor. Imitating a gobsmacked resident, he continues, "But, we have 500 years of water! That's what the realtor said when we bought our house!" The persistence of 500 years of water is not about the persistence of a particular number, but rather the narrative that surrounds it.

Scarcity: 50 Years of Water

Smoketree's number narrative of water abundance began to shift by the 1990s, as property development slowed, new information from the USGS and DWR was released, and the Smoketree Water District revised a Groundwater Management Plan for the Valley. While "the story of the overdraft" implies a singular moment when material reality was forced to contend with unassailable numbers, the relationship between the competing number narratives of 500 years of water and 50 years of water is considerably more complex. Fifty years of water suggested a water world shaped by a technopolitical network of scarcity and erasure, one completely incompatible with the preceding narrative of abundance. At the same time, the scientifically derived claim of 50 years of water relied on a similar logic of objectivity, precision, and simplicity as its predecessor, leaving many residents suspicious of the changing numbers. If Smoketree had previously been the exceptional town with a functionally endless supply of water

—and the growth potential suggested by that abundance—the production and circulation of the "50 years of water" number narrative revealed it was simply one more town drying up.

Local water experts and water managers point to a series of USGS and DWR reports released in 1982 and 1983 as the source of water scarcity, and specifically of the language of groundwater overdraft, becoming local matters of concern. These reports combined analyses of contemporary water use by agriculture, commercial buildings, and residences with predictions for future population growth to produce evidence that water use exceeded natural recharge by approximately 6,000 acre-feet per year. Left unchecked, the reports concluded, quantities of outflow so exceeded quantities of inflow that significant social, economic, and environmental effects were likely to occur. As the groundwater is depleted, residents will begin to experience water quality issues, eventually rendering the water unusable (Moyle 1982; Hatai 1983a, 1983b).

In 2001, a technical committee for the Smoketree Water District began to review and update the Valley's available data, revealing even more drastic numbers. The overdraft was now 17,000 acre-feet per year, and those same social, economic, and environmental effects were now projected to occur in as little as 52 years, depending on projected growth. By 2011, updated measurements and models from USGS and DWR had further validated the basic contours of the story, as well as the ominous 50 year expiration date that circulated in public discourse. Thus, a calculation that was, in its original context, designed to be a provisional number in Lampland's sense (2010), circulated as fixed, static, and constitutive of an entire possible world.

Competing Number Narratives

At stake here is not only a number of years, but who controls the narrative framing of the groundwater overdraft. Interestingly, this brief history suggests that the "story of the overdraft" favored by some technical experts and scientific consultants— in which the community has known for over 30 years that they face an imminent water disaster, but have done nothing in response—itself collapses some 20 years of history and multiple formalizing practices into a particular explanatory narrative. By advocating a story in which adequate data has existed for 30 years, these experts focus Smoketree's broader concern with the relations between water and ways of life into a technical question about groundwater availability. The real problem, this version of the 50 years of water number narrative suggests, is not the numbers themselves, but the people who don't understand their authority.

At the same time, public discourse amongst business owners and community activists honed in on the single round number—50 years of water—re-activating old tensions over water use between resort developers, farmers, and conservationists. Within this technical register, debates were waged over the number's accuracy and implications. Unsurprisingly, many residents perceived this new number narrative as a suspiciously rapid revision of a previous number that (perhaps) had not yet been proven false. Sandra, a local business owner heavily involved in Smoketree's tourist industry, remembers that she responded with suspicion, then caution. "The 2011 USGS report references another report that said 500 years of water, and then, boom! It changed! What caused it to go from 500 to 50?"

Her question raises a compelling point about the politics of erasure inherent in a single number's capacity to stand for an entire system of values, assumptions, and practices. In holding the number narrative accountable to its own history and context, Sandra questions both its

accuracy and its production of objectivity. Noting, as Thomas did, the assumptions about growth in both projections, Sandra continued, "What is the point of view on this [2011] data? How do we come together as a community, how do we manage our groundwater basin, without having trust in the data and in the analyses; without having trust in those that have control over water?" Here, Sandra highlights precisely the same movement described by Asdal: numbers-as-narratives make environmental objects real, but real according to the logics of a particular perspective (2008).

Martin, the Water District supervisor, offered another perspective on the politics of trust, this time stressing the ability of all-encompassing number narratives to render lived experience invisible or irrelevant. He related a story from an "awareness raising" process he participated in during the late 1990s, when the Water District held town hall meetings to gather public input for the development of Smoketree's Groundwater Management Plan. "That's when it [the water shortage] really started coming up," he said, "People knew, they'd had to deepen their wells, but they're not gonna bring it up. We had DWR come down and give talks about the hydrologic cycle, and we had folks showing the graphs." Here, Martin gestured to a well-known graph posted on the wall of his office, showing a self-evident downward trend corresponding to Smoketree Valley's water table. He continued, "And people say, 'just because we're dropping doesn't mean we're gonna run out of water!'" This last objection is a particularly interesting response. Its (unspecified) author may actually have agreed with the diagnosis of the problem—water is becoming more scarce—but rejected outright the corresponding prognosis and response.

Why 50 Years of Water?

Fifty years of water reduced the total environment (ground, underground, and atmosphere), as well as the cultural history of the town, its present, and its imagined future to a single predictive number, and then categorized that number as a newly urgent problem of a particular kind. While this "view from nowhere" objectified and made visible the truly massive scale of Smoketree's water problem across time and space, it also substituted a seemingly objective model for the individualized, more subjective data that comprised it. In its promotion and circulation, 50 years of water encouraged an oversimplified visual narrative of Smoketree's water supply as something like a massive drinking glass, with the water level receding at a steady rate until it hit the bottom.

This distancing was, once again, afforded by the material properties of the aquifer itself, produced through the various practices of measurement and calculation behind the final projections, and then further exacerbated by the rhetorical tactics and translations involved in circulating the number narrative itself. The graph in Martin's office indicates that overall water levels have continued to decrease at a rate of 2 to 3 feet/year. But, given the 3-part tilted basin, the dynamics of the water system, and the differences in direct measurement techniques and equipment, it's entirely possible for one well to show the water level going down while another shows no change at all, or even an increase.

Furthermore, the predictions that extend those data suggested 50 years at a given rate of consumption before negative effects occur, not 50 years of water total. These potential negative effects are the projected result of dewatering the upper aquifer; while the USGS and DWR geologists are fairly confident that the upper aquifer contains a quantifiable supply of clean, easily extractable water, the characteristics of the middle and lower aquifers are more open to

speculation. Thus, 50 years of water is, in its original context, less an expiration date than a marking of the boundary between known and unknown possibilities for the future; it is a provisional number, a best available placeholder subject to revision with better data.

This provisionality was often glossed over in retellings of the number narrative, particularly in contexts where water managers and activists used it as an educational tool for conservation. As Thomas explains it, "People dramatically misunderstood all of it because they were used to thinking about running out of water," where running out manifests in something like turning on the tap and seeing a puff of dust (another frequently repeated visual narrative). The politics of these various visual narratives—the drinking glass, the dry underground lake, the tap that spits dust instead of water—index powerful convictions and fears regarding California's supposedly abundant natural resources. Making nature real and visible through numerical practices creates a particular jurisdictional space for natural resources, giving shape to water in space and time in a way that non-numerical narrative explanations do not. At the same time, however, this quantification already assumes scarcity and finitude; narratives that are perhaps more difficult to accept than simple numbers.

Thomas' telling of events also indicates a deeper tension that reverberated outward as Smoketree's water world shifted from a narrative of abundance to a narrative of scarcity. His subtle move of distinction and differentiation—people dramatically misunderstood it, while there's no dispute among the experts—can be found also in the ways that acceptance of the 50 years of water number narrative articulates and shapes social boundaries in the community and beyond. Nearly all of the self-selected group of water activists and water experts in Smoketree have professional backgrounds as scientific or technical analysts, business owners or managers,

or civil servants, and believe that taking on the responsibility of being an active stakeholder means capitalizing on their knowledge and experience to operate within the technical register of California water management. To use Thomas' shorthand, they are "people who can understand where the numbers come from." In Shapin and Schaffer's terminology, they are the virtual witnesses created and required by the literary technology of the number narrative (1985).

Sustainability = Zero

For Smoketree, the 50 years of water number narrative spoke as both an explanatory model of the town's water world, and a problem statement for its scarcity. The convergence in 2014 of drought politics and groundwater legislation at the state level lent public visibility (and a heightened rhetorical tempo) to issues of water scarcity statewide, contextualizing that number narrative within a broader environmental and technological politics. With it came a new large-scale, longterm number narrative—sustainability equals zero—and a focus on a numerical definition of sustainability as the solution to California's ongoing water problems. This new number narrative reverberated through Smoketree in the form of regulatory benchmarks, groundwater management plan requirements, and technical and legal discourse on rights, modeling, and monitoring. If the dynamic tension between the narratives of 50 years of water and 500 years of water was defined by conflict and mutual exclusion, the introduction and circulation of sustainability = zero presented a different challenge: could the world of water scarcity encoded within 50 years of water articulate with, and potentially transform into, the world of balance promised by sustainability = zero?

Groundwater sustainability is defined by California's scientific, technical, and regulatory agencies as a kind of balance—quantity of water in minus quantity of water out equals zero. If this dynamic, systemic balance is documented and maintained over a period of time, the groundwater system is numerically and hydrologically sustainable, now and into the future. As articulatory practice, then, the number narrative of sustainability = zero articulates future-oriented relations between water and ways of life; if water is made numerically sustainable, and that sustainability is made numerically governable, then the life ways made possible by a stable water supply will be sustained. Zero is crucial as the charismatic round number of sustainability. Similar to 500 years of water, the simplicity and neutrality of 0 allows it to contain the values of balance, equality, and potentiality encoded within sustainability discourse. Its use in practice, however, also calls attention to moments when number narratives become too simple or too expansive for particular kinds of technical or activist work, and must be made to resonate.

Critiques of Sustainability = Zero

There are very real environmental, political, and economic dimensions of Smoketree's water problem that are elided or hidden by the numerical practices of averaging and aggregating that balancing to zero requires, and this was reflected in how sustainability discourse activated old tensions about abundance and scarcity. Richard, a retired hydrologist and 40-year veteran of Smoketree water politics, was quick to point out that focusing only on inflow—outflow . zero re-inscribes the drinking glass from the 50 years of water number narrative, shuttling in its problematic oversimplification and assumptions of value. Here, any discussion of water quality is superseded by water quantity, despite quality being perhaps the more salient issue for many

community members. “We expect that the quality will go down as water levels decline,” explains Richard, “but we don’t know when or how that will happen.” From his perspective, then, the narrative maintains the authority produced by practices of quantification and direct measurement, while glossing over a notable gap in the information those practices access.

Debates over quality versus quantity emerged elsewhere in everyday discourse on plans to make the aquifer sustainable, linking to and re-politicizing the 50 years of water number narrative by opening up entire networks of assumed relations between the geological features of the aquifer, and the geographic and socioeconomic distribution of people living on top of it. As Jackie, a retiree and longtime resident, understood it, most farms are located above the deeper portion of the aquifer in the northern part of the Valley, while most family residences are located above the shallower portion in the south. Because the farmers are above the deeper (and therefore higher quality) water, she speculated, drawing on comments like Richard’s, they could continue pumping a higher quantity of water than anyone else, and water quality issues would affect residents on the other, shallower side of town before it affected the farmers themselves.

By highlighting these differences between quantity and quality within the narrative form of sustainability = zero, Richard and Jackie question the politics of trust involved in buying in to the number narrative wholesale, just as Sandra did when she questioned the “point of view” on 50 years of water. I attempted to ground both Richard’s and Jackie’s narratives relative to the formalizing practices involved in analyzing water quality with Greg, a geologist and technical consultant for Smoketree’s various water organizations. Gesturing to a map of water quality measurements by well location, Greg explained,

> We're pushing the adage that, as the water level declines, quality becomes worse, but we have to address assumptions. There's less good water down here at the southern end, so as you pump that out you'd have to switch more pumping to the north. In that sense, you'll be producing lower quality water in the south faster, but these data show that the water quality in the north is actually worse to begin with!

While Greg narrated the scenario in a scientific register—working around uncertainties and assumptions built in to given calculations—his rhetorical manipulation of the various components of Smoketree's water system raises a similar critique of sustainability = zero. Like Richard, Greg points towards the assumptions of value shuttled in by numerical and narrativizing practices that reduce water's material complexities; emphasizing a potentially misleading quantitative number at the expense of a more uncertain qualitative one. Like Jackie, he gestures to the opportunities for slippage when such a narrative attempts to articulate between technical analyses and economic or policy-planning.

Number Narratives and Social Relations

Discourse on the problem of differently distributed water quality also points to a broader issue made invisible by sustainability = zero: the process of getting to zero collapses all of the individual residents into one envirotechnical system balancing its total inflow and outflow, but water use and responsibility are not (and likely would not be) equally distributed. Most Smoketree public officials and some water activists suggest that the universalizing nature of a water problem makes these differences less important; the claim being that everyone and everything in the town is a water user, equally subject to the availability of scarce natural resources, and so everyone is implicated equally. This logic of relations between and across

individual water users within a water system is certainly reinforced by the rhetoric of California drought policy. However, debates over whether it makes sense in Smoketree specifically further reveal the particular valuations of (and entire political projects around) fairness, equality, and balance encoded within the number narrative of sustainability = zero.

From the 1980s through the 1990s, the most powerful form of differentiation for water advocates in Smoketree was that between professional affiliations that advocated particular water uses; all farmers represented a shared agricultural interest in water, all developers represented a shared commercial interest, and so on. More recently, however, a second layer of differentiation has emerged between those who have enrolled themselves in to the world(s) afforded by particular number narratives, and those who have not. This differentiation is exemplified by the Smoketree Water Stakeholders' Coalition (SWSC), an advisory "problem solving group" of designated community stakeholders originally recruited by DWR, and partnering with the Smoketree Water District, USGS, and San Diego County.

The SWSC, like many stakeholder groups, attempts to speak in one collective voice, which represents over 80% of the Valley's water users (a calculation based on relative water consumption and stratified by use). The SWSC's collective voice speaks through and with number narratives as a way to simplify the water problem and build consensus around an alternative water world. As formalized in their memorandum of understanding and subsequent public reports, their work is underwritten by the members' individual acceptance of the story of the groundwater overdraft, even if they agree to disagree on some details of the 50 years of water number narrative. In response, they have advocated a set of recommendations that link the 50 years of water narrative with sustainability = zero. By agreeing both individually and collectively

to adopt sustainability = zero as the solution to the problem posed by 50 years of water, they agree to hold competing values, perceptions, and entire ways of economic life in tension to allow for collective action. Here, "zero" does not simply stand in for balance, but also operates as a positive actor opening up a particular future of collaborative water governance.

In promoting their work (and their number narrative) to the general public, the SWSC found themselves adjusting to critiques of sustainability = zero; insisting that reaching zero is the single most important goal for the community's future (adhering to the technological framing that provides a call to action in response to a calculated threat), while also admitting that that same zero could be a misleading objective for what it collapses, or what it renders invisible (affirming the right of each interest represented by the SWSC to act in its own best interest in regards to water, even if those interests are in direct conflict). In doing so, they enrolled the number narrative of sustainability = zero in to a politics of consensus, where it produced a kind of precision that derives its value from social practices of collaboration and facilitation. In Ballestero's words, "These speaking numbers would tell the stories they wanted them to tell" (2012, 228), while gesturing to a sustainable future in which the SWSC operates as a vital political actor.

More so than any other number narrative in Smoketree, sustainability = zero had the capacity to articulate between technology, policy, and discourse, as well as between local and state scales of analysis. This is not only due to its compatibility with bureaucratic values of transparency and translatability in public knowledge—that is, its ability "to coordinate the activities of diverse actors, and to lend credibility to forms of belief and action when personal trust is in short supply" (Porter 1992, 640)—but also for its affordances as a provisional number

to be used in group planning and strategizing (Lampland 2010). Grounded in this high stakes discourse over the future of Smoketree's water management, and placed in relation to the formalizing practices that validate its authority, sustainability = zero operates as a purposefully simple provisional number; a temporary placeholder that different individuals and groups can deploy to stand in for (and perhaps delay discussion of) a network of relations understood to be in flux. Thus, while the numbers in Smoketree's narratives of abundance (500) and scarcity (50) operated as fixed, objective signs constitutive of facts, the number in the narrative of sustainability (0) operates as both numerical descriptor and open container; representing the end result of a series of calculations, while also holding assumed relations of how local water works in dynamic tension.

Conclusion

As scientific and technical experts, policy-makers, and community leaders work together to respond to environmental problems like water shortages, they rely on practices of quantification to simplify and communicate about scope, scale, and stakes. Numbers define the boundaries of the problem, both temporally and spatially; they encompass who (and what) is affected, when, and what must be done. They allow for translation, connection, and articulation across publics, and between expert and everyday spaces. In short, numbers become a site at which key practices of ecology building occur.

At the same time, numbers do not by themselves make ecology building seamless, easy, or universal. As I have shown here, analyzing numbers as narratives, rather than pulling them out of narratives, reveals how practices of quantification and formalization work (or don't work) in

context. Number narratives serve as an entry point for illuminating how numbers about water were produced and circulated; how competing numerical stories framed problems, solutions, and life ways; and how number narratives worked as articulatory practices that shaped particular environmental, technological, and political systems. At stake in the production, circulation, and interaction between different number narratives are larger questions about how environmental objects like water should work, what (and whose) forms of life they should support, and how. In Smoketree and elsewhere across the arid Western United States, number narratives show how water has been made to matter, both materially and symbolically.

Carolyn Merchant writes, "Science is an ongoing negotiation with non-human nature for what counts as reality" (1989, 4). I propose that numbers are also an ongoing negotiation for what counts as reality, and for whom. Discourse about how numbers corresponding to water work, and how and when they come to matter, reveal precisely the forms of technopolitics and formalizing practices that are brought to bear on water problems in the first place, and how the continuance of these politics and practices sustain California's envirotechnical regime as normative. In the following chapter, as I shift out of Smoketree and out of a specifically numerical register, I highlight the labor of working both within and against that regime in the form of water advocacy.

WINTER: SNOWBIRDS

Like most small towns, Smoketree Springs has a handful of restaurants that are just as reliable for news and gossip as the local paper. In this case, a sandwich counter named Calico's serves as the daytime hub, and a central meeting spot for those (like me) with the time and inclination to keep watch over local goings on. During one of my many long lunches with Jesse, a semi-retired astrocartographer, and William, an artist and caretaker, we trade stories of our favorite local hiking spots. Jesse is partial to the abandoned plots next to the field station, remnants of a golf course project from decades past that was never actually completed. "You can still see the way they mapped it out, if you look closely," he says, insisting that the cacti and ocotillos there are also lovely. "It's a good place to go when the crowds come back. This place is gonna fill up!" A young woman at the next table perked up at the mention of pretty cactus, and interrupts to ask Jesse where she could find them. His words are friendly, his tone and facial expression a bit less so. Gesturing to the desert beyond the road, he says "they're everywhere!" then turns back to William and me, rolling his eyes. "Tourists."

As winter sweeps across the desert and the heat tempers, resort towns like Smoketree swell with a migration of seasonal residents, weekenders, tourists, and other so-called snowbirds. Some are fixtures in the town, uprooting their entire lives to second homes in the desert for nine months of the year. Others rent lodging for the season, pass through in their motorhomes on a circuit returning from more northerly summer destinations, or pop in from the coastal cities as their work schedules allow. Over the course of a few weeks, the population grows from 3,500 to over 7,000.

Whether these occasional residents are considered true locals or "out of towners" is the subject of much debate. Scheduling events outside of "the season" is a loaded proposition, with consequences ranging from low turnout at art shows or geology classes, to accusations of secrecy or obfuscation for public hearings and community board meetings. "If you schedule your town hall in May," the President of the local Water District Board shrugs, "people assume you're trying to hide something from the ratepayers."

Of course, your perception shapes your reality. A geotourism council recently formed in Smoketree to shepherd future development and tourist infrastructure under the umbrella of environmentally-friendly smart growth that preserves a sense of place. The question then became: *whose* sense of place? At an early council meeting, one weekender remarked that the Desert Club, the exclusive mid-century country club responsible for the stunning building now serving as the field station, had had a vision for the future, and that vision shaped functions for the Valley through the 1950s and 60s. "We're in need of a new vision," she explained, kicking off an enthusiastic discussion of various hopes, dreams, and fantasies that could be projected on to the town's future. That this example generated such a positive response is itself indicative of the perspectives of those in the room. Smoketree Springs Valley did indeed prosper under the Desert Club's singular vision of Sunbelt leisure culture, and its history is told fondly by local historians and long-term residents. But, that prosperity came at a time when Smoketree was still essentially a company town, under near total control by agricultural dynasties and development firms capable of performing their own gatekeeping, and imposing their own racialized class system.

It's a fine line to walk, preserving the artifacts and recapturing the optimism of the past, while also acknowledging its more insidious legacies, and seeking to redress them in ways beyond mere tokenism. Although its members strive for inclusivity, the geotourism council struggles to avoid the same pitfalls as similar projects in seasonal tourism-dependent small towns all over the rural Western U.S., where small growth and no growth shuttle in arguments over who should get to live in a place in the guise of supposedly neutral statements on the capacity of resources. Here, "we are a seasonal resort town" can quickly become code for "we are a town of wealthy, mostly white, mostly older people," while ignoring or excluding all the people that make that lifestyle possible.

And yet, for some, the bottom line is the question of who matters more: the people who live in the desert year-round, and thus can claim, as William and Jesse do, to truly know it? Or those who merely visit during the good times or the easy times, and perhaps see only what they want to see?

CHAPTER 4: EMPLACED ADVOCACY

Introduction

"No one is going to speak up for this. *We're* the ones who have to advocate for the places *no one cares about*."

Diane's voice carries a touch of cynicism earned from years of experience as an environmental activist, but here, at least, she is preaching to the converted. Every winter, the Sierra Club's Desert Committee - a regional network of volunteers from the Sonoran, Mojave, and Great Basin deserts in the Southwestern United States - gathers in remote Mesquite for a weekend huddle, sharing information and organizing the group's current and future priorities. There is official leadership present from the nearest office in Los Angeles, but this meeting is not truly theirs: instead, it is run and enlivened by an older generation of semi-professional and volunteer activists like Diane, many of whom live in the same places they work to protect, and supported by a network of local public land managers.

This dynamic was repeated across the communities in which I conducted my fieldwork as a lived topology of advocacy, where individuals and groups practice the kind of activism that matters for their particular relationships to their local environment. Whether organizing to fill voids in places with no formalized municipal structure of governance and public participation, or responding to county or regional government groups perceived as acting against their interests, local water activism emerged in the form of a regional assemblage of self-appointed advocates for places no one else could or cared to advocate for. This is more than just activist topophilia (Tuan 1990), belonging to and speaking for a particular place as part of ones identity. Following

ecology building as a mode of attention, this chapter explores what it might mean to think of water advocacy as deeply *emplaced*, situated both politically and ecologically.

In what follows, I examine the ad-hoc regional constellation of advocates brought together in response to local water problems in four places: 1) aging conservationists fighting to protect small groundwater supplies from industrial development in "sacrifice zones" along the US/ Mexico border; 2) environmental justice activists organizing and professionalizing a form of civic engagement connecting deeply polluted disadvantaged communities to powerful actors at the state and national scale; 3) artists, tech developers, and utopian dreamers trying to save the Salton Sea from a distance by ushering in a new era of big water projects; and 4) self-appointed stakeholders navigating the question of who gets to be "at the table" in California's new era of local groundwater governance. Along the way, I examine the dominant models of advocacy for each community of practice - sacrifice, civics, saving, and stakeholders - and how these models both shape and are shaped by their locally specific water worlds (Hastrup 2014).

Analytical Frameworks

There are many possible analytical approaches for apprehending projects of environmental advocacy and activism, from environmental justice scholarship documenting the unequal distribution of the effects of industrialization and capitalism (Auyero and Swistun 2009; Checker 2005); to anthropological studies of power and localized responses to the environmental impacts of globalization and climate change (Peterson 2015; Tsing 2005); to STS-inflected case studies of mitigation efforts for toxic infiltration and extractive industries (Little 2013); to broader theoretical considerations of the projects and politics of ethics, care, and obligation, particularly

in spaces where some kinds of suffering (and some kinds of subjecthood) are made to count more than others (Murphy 2006; Petryna 2003; Povinelli 2011). This chapter is written in conversation with this existing scholarship, and in many ways follows the same narratives of self-selection, participation, recognition, and refusal from activist individuals and groups.

At the same time, I recognize that certain forms, patterns, and narratives of environmentalism and environmental activism in the United States have become naturalized, both in their enactment and in their analysis by qualitative social scientists. I push back against this naturalization in two ways. First, I seek to mount a loving critique of advocacy and activism; one sympathetic to the ways in which these communities' urgent water problems have been caused, exacerbated, suppressed, or ignored by those in power, while also recognizing that the work of responding to them is often (and perhaps necessarily) imperfect, and may even reproduce the same patterns of privilege and exclusion it seeks to redress. As such, I build on work such as Checker's focus on discourse, kinship, and social organization to construct a narrative of hope, where community advocacy, narrativization, and self-organization do not have to be successful in order to count as valuable (2005), as well as Fortun's notion of activists as enunciatory communities brought together by shared context and an immediate shared goal, but nonetheless maintaining internal dissent, heterogeneity, and fluidity over time (2001).

Second, and following ecology building as this dissertation's central organizing concept, I highlight how water becomes embedded in complex, particular ecologies of practices, held together by social technologies of belonging (where belonging is defined by a sense of practitioner obligation), and where "there is no identity of a practice independent of its environment" (Stengers 2005, 187). In studies of water and its politics, water is not just a

practical necessity, but often comes to embody the conflicting, locally specific values projected on to it by the people who live with it: as a human right, an economic good, a sacred giver of life, and so on (Bakker 2014; Ballestero 2014). And yet, while there are attempts to recognize this tension in California's top-down system of water governance - where water's publics are represented via stakeholder statuses associated with categories of water usage (municipal, commercial, agricultural, environmental) or inserted into the process via broadly conceptualized values (environmental justice, sustainability) - the actual practices of water advocacy and activism are flattened in the process. The motivations of individuals and groups are reduced to their water use, and values are assumed to be static, commensurable, and translatable (or scalable) to *all* water problems, regardless of context (Espeland 1998). Instead, I attend here to how different groups of interlocutors figure their relationship to the environment as one of emplaced advocacy*;* that is, not only a relationship based on advocacy, but on the advocacy needed for a specifically located place and its water. I trace how certain forms of advocacy emerge in relation to local specificities, and how advocates position themselves within broader regional networks of environmental activism and water governance. In so doing, I show both the richness and diversity of practices that emerge in response to local water problems, and the labor and sense of belonging required to maintain the ecologies in which they occur.

Sacrifice

Helen lives alone on a sprawling homestead she calls "the last house before the border," far on the edges of the 300-person town of Palo Verde. Her home, and especially her office, where she works in the dark at her laptop late into the night, is crowded with books and government

Illustration 4.1: The last house before the border. The view towards Palo Verde (and the local wind farm) from Helen's property.

documents. She jokes that her home is an outward manifestation of her brain, the material detritus of a life spent tirelessly pursuing her various causes. Books and papers aside, Helen's lifestyle is thrifty and minimalistic, and she takes pride in listing the amenities she foregoes to maintain her independence and direct connection to the desert environment. Her home is partially underground, cooled by the earth and warmed by body heat. Her outdoor shower, outdoor sink, and outdoor stove may be a bit more work, but she insists they're more reliable and pleasant to use than their temperamental indoor equivalents. She lives on social security payments, but still manages to donate money and attend medical conferences by keeping her daily expenses radically low. For her, this lifestyle is a conscious choice, but she is quick to remind others that many people live in the desert because they cannot afford to live anywhere

else. She sees herself as, in part, the voice of a generation of aging residents who moved to the desert for some combination of solitude and affordability, but have now been marooned in small towns abandoned by the industries and people that once kept them alive.

Helen didn't intend to be a community activist. She and her husband, both avid hikers and conservationists in the mold of Leopold's land ethic (1966), had long been involved with the Sierra Club's efforts to protect wilderness and endangered species. It wasn't until the late 1970s, when they noticed the water level in the well on their property dropping rapidly, that they began to think of themselves as also in need of advocacy, representation, and care. Helen began gathering information from anyone who would talk to her - planners in Imperial County, scientists with USGS, experts in the Sierra Club - and eventually learned that Palo Verde's groundwater was being pumped and imported by the construction materials manufacturer United States Gypsum Corporation to their industrial site at nearby "Plaster City," just on the other side of their groundwater system's hydrologic boundary. Repeating the story now, she structures the narrative around an overwhelming mix of technical details, court cases, and "off the record" conversations delivered in rapid fire, with barely a breath in between. Imperial County's 1972 General Plan proposed that Palo Verde could support 22,000 people plus agricultural development on their own groundwater, but that same year the County Board of Supervisors made a contract with USGS to begin monitoring groundwater levels (which, in Helen's eyes, suggested that they already anticipated a problem). Imperial Irrigation District gained approval by 1982 to extend their service area and sell Colorado River water for industrial purposes, but instead US Gypsum pursued an entitlement to 767 acre-feet of local Palo Verde groundwater per year because groundwater is "free," even though Palo Verde's aquifer was already overdrafted. In

1993, the County's own expert said on the record that US Gypsum should never be allowed to pump more than 400 acre-feet per year, and was subsequently asked to vacate his position. US Gypsum instead signed a monitoring and mitigation agreement with the County stipulating that, if Palo Verde's groundwater is contaminated or depleted, they would provide bottled water to local residents for ten years, but then they have no further obligation to the town. A lawsuit Helen and others filed in 1999 is still working its way through the appeals process, but she isn't hopeful.

The story builds to a well practiced conclusion I've heard Helen use many times over the two years we've spent together. "The County doesn't like me because I'm challenging them on US Gypsum, and the County would rather do whatever they want than have any community out here. It's because the desert has been designated a sacrifice zone for the affluent cities on the coast. There's even a report telling you how to cite locally undesirable land uses: find a place with a poor, uneducated population, where they can't fight back. The county won't stop it, because the county will do whatever the developers want. They're not thinking about the people who have to live with it, who can't afford to move. We're a sacrifice zone. Waste land, waste people."

The Ecobiopolitics of Sacrifice Zones

As I followed her work, Helen surfaced the regional network of activists living in an archipelago of small rural towns off of Highway 8, paralleling the U.S./Mexico border, and volunteer and para-professional advocates connected through the Sierra Club's Desert Committee. Although many in this network are past retirement age, Helen is one of the true

elders; an experienced and knowledgeable hand whose name is passed on through friends of friends, often to those in need of expertise and connections they can't access on their own. Most of her fellow mischief-makers, as she calls them, aren't as comfortable referring to themselves as environmental justice activists,[10] but the sacrifice zone narrative (and the logic of the desert as a disposable waste land) is one I heard over and over again. A sacrifice zone is a geographic area that has been permanently damaged by some combination of pollution, environmental degradation, and economic failure. The term is often used to refer to toxic waste dumps or nuclear fallout zones, with the concept (and its attendant logic of allowing some to die so that other people, places, and things might persist) emerges frequently in studies of militarization and toxicity in the Southwestern United States (Masco 2006; Kuletz 1998). In contemporary activist discourse, however, sacrifice zones can also be prescriptive: places that have supposedly been singled out as acceptable losses in a world struggling to reconcile newly visible environmental scarcity with cultural and economic imperatives for continued growth and production. In this sense, the assertion that one is part of a sacrifice zone is an assertion of ones precarity within an ecobiopolitical system (Olson 2010).[11]

Helen and her longtime friend, Alice, explained this mezzo-scale perspective over lunch one day, as they traded stories from their shared history of fighting illegal water exports,

---

[10] While this is an interesting dividing practice, I want to be careful not to misstate or overstate its meaning. Helen built her comfort with this language through practice, by participating in the Environmental Justice Task Force described later in this chapter and conducting her own research. She recognizes that the justice framework has power and legibility, and so she frequently emphasizes in her work how environmental issues disproportionately impact poor communities, the elderly, and people of color. Others, like Alice, prefer the term "community activist" or simply "environmentalist." It's tempting to say these differences are a matter of generation, class, or exposure to environmental racism, and there is certainly truth to all three. But, they are also a matter of performing institutional legacies (for example, whether someone "started" as an environmentalist with the Sierra Club or a farmer's rights advocate with an agricultural trade organization), and perceptions of what counts as "the environment" and how humans relate to it (for example, whether one considers toxic pollution from industrial development in rural areas to be primarily an issue for land degradation or for human health).

[11] That is, one in which subjecthood is fundamentally ecological, as well as biopolitical, and where neither can be subsumed under the other.

irresponsible development, and toxic pollution in and around their hometowns. Alice has even brought a visual aid: the map from an Environmental Impact Review of the area, blown up and printed on a large poster board. Colorful polygons with names like “Sunrise Power site” and “Tulare Mine” splatter across a highway corridor just north of the border, and east of the last suburbs of San Diego. Some are obvious pollution threats: mines, waste disposal sites, military training facilities with live fire. Others capitalize on good intentions: wind farms sited too close to residential areas, solar farms that would require massive exports of scarce groundwater. All are spread across a rural area perhaps 60 miles across, and containing a few thousand people at most.

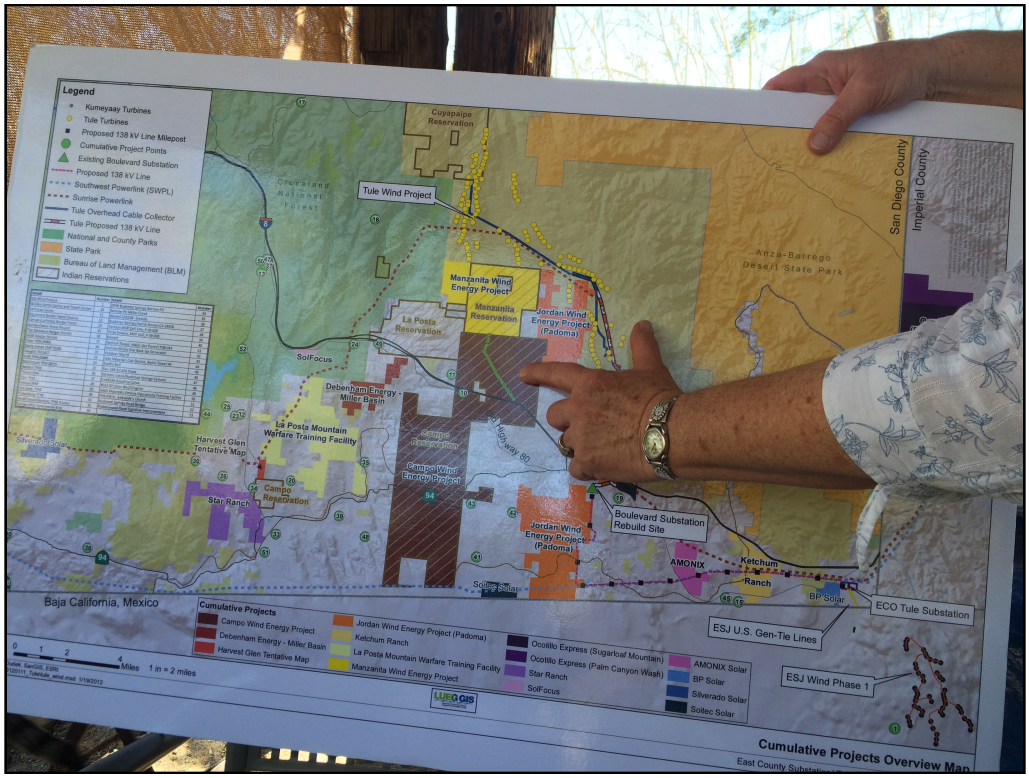

Illustration 4.2: Mapping sacrifice zones. Alice walks us through the many industrial projects sited near her and Helen’s hometowns.

Pointing to boundary lines on the map, Alice explains, “So here's the San Diego/Imperial County line, and there's Palo Verde and all these projects in Imperial County. This is eastern San Diego County, and this is Ironwood [where Alice lives] right in here. This is our residential

area." Moving on to the shaded polygons, she begins listing off the many industrial projects sited on the map area, "This was the Campo Wind Energy project on tribal land, that one's now gone. This is existing wind turbines by the Interstate 8, if you've ever seen them. These yellow ones are the Tooley wind turbines. That's been approved; we've got a ninth circuit court of appeals hearing coming up in April. These blue ones were the Soytech solar. This one was approved and this one was approved, but we delayed it; there was so much delay and ineptitude on their part that they lost out of their contracts…" The sheer scale and concentration is overwhelming, as Alice intends. Helen chimes in, "It's a real racket. There's nothing for the local community. All the negative stays local: the air pollution, the seismic activity, the electrical pollution, the water use. And nobody seems to care! 'Well, we don't have to deal with those people on an everyday basis, so we forget about it.' Having people here is nuisance [when] there could be much more development."

Knowledge Politics

Alice, a third generation farmer, took up her father's mantle in local water wars when a proposed landfill site threatened the safety of her property's groundwater supply. She never graduated from high school, but nevertheless taught herself to read and write planning documents and legal briefs, largely on the fly. Her first big victory was securing sole-source aquifer status for Ironwood's groundwater, which she only accomplished after years of haunting the offices of multiple water agencies and her local congressman, gathering information and learning the various agency jurisdictions and hierarchies (although she says that public speaking and having to install a phone on her property were the biggest challenges). She describes a time

when she and other community activists were deposed for over eight hours in a legal case brought against a mining company. At the end of the deposition, Alice was the only activist whose actions had met the demanding requirements for legal standing, and she alone could continue the suit.

Alice is rightfully proud of her bootstrapping personal history. In this complex system of environmental governance, preserving ones right to be heard and recognized in opposition means waging a war of attrition through board meetings, public hearings, "notice and comment" processes, and legal cases, where success is won by the painstaking accumulation and interpretation of technical data that is nominally public, but nonetheless hidden from view. In performing this very specific model of subjecthood, Alice and others build their authority in two ways: first, in speaking as residents whose accumulated local knowledge and daily lived experience serve as counterpoint to outsiders who don't understand the desert environment or its people; and second, by marshaling a preponderance of data more reliable and truthful than any one human actor. The sense of living in a sacrifice zone impacts knowledge politics as well, as Alice and Helen see these places and people as dumping grounds for "bad" information: rushed and inaccurate Environmental Impact Reviews (EIRs), maps that blatantly misplace boundaries and geographical features, and officials who assume no one will fact-check their statements.[12]

Combined, this means that much of their activist work is simple research and reportage, but the standards and stakes of doing that work *well* (that is, in a way that is both locally specific and broadly reproducible) become politicized. For example, the theory that initial EIRs for

[12] In this sense, Alice and Helen's experiences are representative of a broader trend in water stakeholder politics towards what Hanak et al. call "combat science," where decentralization of water governance and a lack of independent scientific and technical assessments have given rise to "popular and politically useful myths that hinder serious discussions and negotiations of water policy" (Hanak et al 2011, 7).

undesirable projects are done poorly on purpose, either to avoid wasting time on an uneducated public or to force commenters to wade through and correct a mountain of bad information before they can do anything else, is widely accepted within local activist circles. Within this context, it makes sense that, when years of frustration finally moved Helen to protest the deep unfairness of this model of activist participation, she did so by refusing to share information. Standing before Imperial County's Board of Supervisors during the public comment period of their regular monthly meeting, she spent her allotted three minutes describing why she had not submitted a comment letter for a proposed project in advance, and why she would not be attending a stakeholder outreach meeting on the same topic. While the Board seemed relieved by her actions, to Helen, they represented the breaking point of a life spent sacrificing time, labor, and skill for a fight it was predetermined she'd lose.

Sacrificing Bodies and Land

Helen feels deeply, and her connection to the desert lands she loves is at once intellectual, emotional, and somatic. When she tells stories of her past encounters with dying and endangered landscapes, she weaves in her own body's corresponding reactions, both present and future. A covert "tour" of the Ivanpah solar farm in the Mojave Desert produced a noxious buzzing in her bones that made her sick to her stomach; she could only imagine what the birds and insects "zapped" by the focused beams of light would feel. A monitoring trip to record the noise pollution in homes next to the Palo Verde Wind Farm with scientific equipment made her head spin and her limbs crackle with ambient energy. The consultant she and Alice had hired merely confirmed what their bodies already felt: the environment around them was soaked with invisible

toxicities, slowly killing anyone forced to live there. The tireless work of activism itself breaks down bodies as well. Both women are well into their seventies, and suffer from chronic lyme disease[13]. They've noticed that their strategizing sessions are increasingly peppered with stories of doctors' appointments and darkly humorous takes on new symptoms. Helen jokes that she doesn't understand why her pulse has been so high lately; after all, she skipped three County hearings this week, so it's not like she's had a lot of stress!

I've asked if either of them have much faith in the next generation of environmental activists. Our conversations have often circled back to the Sierra Club; the mainstream environmental organization lent credibility and legal support to many of their earlier fights, but has since shifted its institutional attention away from rural development issues. Helen reminds me of a meeting we attended together, where a young spokeswoman from the Sierra Club's office in Los Angeles arrived late, left early, and barely talked to the crowd of older, rural volunteers in between. "She's the head of the green energy campaign," Helen reminds me. "They've been so indoctrinated that green energy is good, and so many of them don't get out to the backcountry and don't see the impacts. Even the San Diego chapter, the conservation committee only deals with urban areas. They're not going to say anything against renewable energy development, even if it sacrifices the poor people out in the desert."

Helen and Alice are the last breath of a kind of environmental activism that's reaching the end of its life. It's already an uphill battle: factoring in both the kinds of personalities that tend to move to the desert ("people move to the country to be left alone, including me!" says Alice) and the continued aging of rural communities across the United States (Glasgow and Berry 2013),

[13] An unusual condition for the desert, where tick-borne illnesses are quite rare.

it's difficult to find allies willing and able to put in the kind of commitment their work requires. Alice continues with exasperation, "All this crap going on in these little tiny communities, and generally one or two activists who are trying to keep track of it all, keep everybody informed. Because it's hard for most people." And now, few young people are conservationists at all, let alone conservationists willing to prioritize the purity of sparsely populated, unproductive "wastelands" over the health and continued growth of cities. Conservation is old; sustainability and efficiency are the language of the new environmental movement.

Civics

In March of 2015, California's State Water Resources Control Board called for a public workshop to re-evaluate the state of the Salton Sea, the complex and notoriously disastrous salt lake in the southeastern California desert. Nearly 200 people responded to the call, converging on a hearing room in downtown Sacramento to give testimony on mitigation and restoration projects, consider drought impacts, argue for the Sea's environmental and economic value, and discuss the enormous water transfer agreements that threatened to damage it even more. Among them were the expected powerful actors in Imperial County (the County Board of Supervisors, and the notorious Imperial Irrigation District), mainstream environmental groups, public lands organizations, and a collection of smaller community organizations and private citizens.

For Roberto, the Director of Imperial County-based community non-profit Comite Civico de Valle, there is a secondary struggle playing out in the room; one read through subtle cues of language, seating choice, position on the day's schedule, and reactions from the Board. Roberto inhabits a complex professional space of constantly shifting allegiances and obligations between

differently situated advocates, lobbyists, government officials, and practitioners. He has an ethnographer's eye for detail, and is keenly aware of his organization's relative position and reputation within this space at all times. As he sees it, his practical ability to observe, learn, strategize, and sometimes compromise has enabled him to maneuver Comite Civico into its current position as a trusted and powerful advocate on behalf of the disadvantaged communities in Imperial County, the poorest and most polluted county in California. From this position, he is able to divert resources to locals, support their own projects, and start solving problems. He is here today not just to represent a place to people who haven't lived its story, but to participate directly and equally in the civic processes that decide its fate.

In many ways, this is a typical environmental justice story of the politics of recognition, representation, and refusal; where individual activists from a marginalized community of color organize to speak up for those who have been erased, and defend their rights against powerful actors in industry and government. For Comite Civico, however, this is also a story about building the forms of advocacy urgently needed for this community, in this place, at this moment. In conceptualizing advocacy as a particular kind of civics - one that is strategic, relational, professionalized, and adaptive to both Imperial Valley's and the Salton Sea's particular disaster ecologies - Roberto and his fellow organizers articulate locally meaningful forms of community organizing and restorative justice with California's complex, multi-scalar environmental bureaucracy.

Disaster Ecologies

As a semi-permanent disaster landscape, the Salton Sea is best defined not by the fall-out from a singular event, nor by the slow accumulation of risk, but by a decades-long dynamic tension between mitigation of danger and restoration of health. Attempts to define the problem and its stakes have gone on for decades, but it is still far from clear whose fault is it that the Sea is still shrinking, still dying, or still dangerous, or, for that matter, if anyone can (or should) keep trying to fix it.

Illustration 4.3: On the shores of the Salton Sea. Dead, dried up fish and barnacles litter the shoreline.

The Salton Sea's history of boom, bust, failure, and rescue is a century long. During the desert agricultural boom of the early 1900s, engineers for the California Development Company built a series of canals to irrigate the Imperial Valley with water from the Colorado River. When outflow from the river overwhelmed the canal system, water filled the dry lake bed at the Salton Basin, (re)creating a modern-day lake. As water levels stabilized, the Sea enjoyed a brief mid-century heyday as a popular resort area. Over the following decades, however, continued evaporation, and water flows saturated with sewage, agricultural chemicals, and salt made the Sea poisonous for most wildlife and potentially dangerous for humans. By the 1970s, tourists had left, property values collapsed, jobs

evaporated, and plans to "save" the dying Sea began circulating in earnest. Today, its waters are maintained by a delicate network of rivers, agricultural runoff from surrounding farmlands, and drainage systems, all combining to mitigate the impacts of natural evaporation, and keep the harmful materials in the lake bed buried under water. Without a steady supply of water, local residents face hazards like exposed toxic lake beds, and airborne agricultural chemicals.

As with groundwater, debates over whose problem the Salton Sea is have taken on heightened urgency in the context of drought and climate change. In 2003, before California's current "exceptional drought" began, the Imperial Irrigation District (which serves the Salton Sea area) signed an agreement to transfer some of the Colorado River water currently flowing to farms in the Imperial Valley (and, via agricultural runoff, to the Salton Sea) to other water agencies, and specifically to thirsty urban centers like San Diego. The Imperial Irrigation District agreed to provide fifteen years of "mitigation flows" to slow the impact on the Sea, while the State would use those same fifteen years to support a simultaneous restoration effort bringing the Sea to a state of sustainability. The public workshop in Sacramento was called in response to the approaching end of the mitigation flows in 2017, and to accusations that the State had not followed through on its part of the bargain. For those activists who urged the State to intervene, this was not just about keeping local water in place to keep their communities healthy, it was also about holding California's water leadership responsible for the unintended consequences of large-scale, good-on-paper systems logic run amok. The water transfers may have boosted San Diego's urban residents and Imperial Valley's agribusinesses, they argued, but this came at the expense of already vulnerable populations living around the Sea itself. For example, air quality is a particular concern for Imperial County. Between agricultural chemicals and burning,

transportation emissions, and trans-national pollution from Mexico, children here are three times more likely to be hospitalized for asthma compared to the rest of the state. Allowing toxins buried under the Sea to become airborne would only amplify an already dire situation.

Emotions are running high in the hearing room. John, a retired local politician and frequent collaborator with Comite Civico, is seated to my right, and he helps me interpret the history of disaster politics playing out in the room. The crowd has even separated itself according to profession and position, he says: water agency directors and businessmen to the right; community organizers and environmentalists to the left. The morning's schedule is stacked with speakers from the former group, and their technical arguments about legal obligations, water transfers, and public health statistics provide a bird's eye view of the incredible work and resources required to maintain large-scale, long-term mitigation. As they speak, John provides running commentary: how convenient that IID's speakers are allotted the most time, the head of the Farm Bureau didn't mention they're compensated generously for giving up their water allocations, get ready for the County Board of Supervisors to pretend they care about public health, and so on.

Illustration 4.4: Why restoration? Speakers representing Imperial Irrigation District give comments before the State Water Resources Control Board.

Eventually, the environmental and community organizations are given the chance to speak. Fifteen years of holding open that space of mitigation/restoration in a place already known as a semi-permanent disaster zone results in a mix of hope and frustration. Speakers slip between practiced technical and affective language to describe the hazards of exposed lake beds, airborne agricultural chemicals, and disappearing industries, ending with calls for the State to intervene so that one of the many plans already on the table can finally move forward. Of course, it's not that simple, and again John offers commentary. If the stakes involve competing interests from farmers, farm workers, renewable energy developers, water companies, school children, seniors, asthma sufferers, birds, fish, and even global climate, then what (and whose) Sea are we trying to fix, and who are we putting in charge of it?

Organizing the Local Community

Comite Civico's story is Roberto's story as well. His father, the organization's founder, was one of the many farm workers who immigrated from Mexicali, Mexico to towns just across the border in the Imperial and Calexico Valleys. Although their community was (and is) largely Mexican, Roberto and his sister faced intense discrimination as, in his words, "people who weren't really *from here.*" At school, he remembers being placed in ESL classes with the other children of migrant farmers, where teachers assumed that because he couldn't understand English, he couldn't understand anything else either. This experience profoundly shaped his entire family; years later, in 1987, his father founded Comite Civico to help future generations get a better education, and prepare for a life beyond working in the fields. Roberto explains, "He [my father] knew that a lot of these injustices that were happening originated in the school. And

so what drives the organization is education, the lack of equitable education for migrant students, which drove the need to have parents involved. And that's where the whole concept of 'civic engagement' came in." Over the next decade, the organization acquired non-profit status, and expanded to include a range of services for the migrant community: education on the citizenship process, advocating for representation on school boards and in local government, and a community health program training promotoras to work with isolated rural communities.

Roberto's narrative of Comite Civico's history is peppered with personal stories in part because his activist work has served as both a personal awakening, and a means by which to reconnect with and recover from past injustices. He managed a successful restaurant for most of the 1990s, occasionally lending his business expertise for projects like grant applications. He remembers researching pesticides when he first joined Comite Civico full-time in 2000, and how he began to remember vivid scenes from his past, like walking in the fields with his father, and watching the smiling pilot of a crop duster fly overhead and spray them both. "I remember so clearly that he *smiled*," he says, "It became so offensive to me, that this had happened. I just didn't know." Inspired, he gathered allies from other non-profits and research institutions to pool resources and expertise, and help launch bigger projects aimed at empowering the local community through education and knowledge. He explains, "If you help others going through injustices, you're recovering things you lost. And I'm recovering things that I was denied, that I lost." He began, in effect, to remember his hometown differently, and to re-articulate his sense of belonging to it not only as a now-successful local businessman, but through his father's mode of civic engagement and community recognition of past and present harm.

Today, Roberto rattles off an incredible list of citizen science projects accomplished by Comite Civico and its partners. In 2005, they conducted the the most complete, most significant study of asthma to date in Imperial County. They worked on a water quality study with the California Department of Public Health, and another on water contamination with the National Latino Research Center. He's been able to connect with an enormous network of environmental justice groups in California, across the nation, and across the border in Mexico. Their signature program is IVAN, the Identifying Violations Affecting Neighborhoods program designed and launched with the state Department of Toxic Substance Control (DTSC) in El Centro, which streamlines the way that local communities engage with environmental protection agencies, and creates greater transparency for government actors. IVAN is a locally appropriate technology (Fortun 2004), a crowdsourced GIS database that allows residents to easily monitor, document, and report local environmental problems like toxic leaks, burning agricultural fields, and broken wind turbines through an app on their phones, and automatically sends them to the appropriate agency. The reports are archived online, and available to the community as verified (and verifiable) data. Follow up is conducted at monthly Environmental Justice Task Force meetings with the DTSC, where the reports are reviewed and discussed by Comite Civico and other community organizations. They've had to choose their partners carefully, but they've learned to work only with those that value transparency, accountability, and equity; fortunately for Comite Civico's profile, these tend to be prominent universities and state and federal agencies that allow them to circumvent and work against the worst impulses of local County government.

These experiences shaped Comite Civico's present focus on environmental health and justice as the target of civic engagement, and Roberto's own practical approach to getting work

done through a network of partners and supporters. He is deeply and passionately invested in the mission of environmental justice: "We [at Comite Civico] believe that everybody should have opportunities. That natural resources belong to everybody. And that benefits need to be available to everyone as well. We're not denying people the mentality of capitalism, but not at the expense of people. That's what we're always gonna stand against. We're not gonna stand for industries to come in and insult our community by polluting, by over consuming our natural resources, and then passing on the costs to the more vulnerable and poor people." At the same time, he notes that years of working with experts outside of the world of community organizing have shown him the value in different ways of tailoring this message, even if doing so means sacrificing a bit of its ideological purity. "We're about solving the problem," he explains, "and sometimes that means compromise. Environmental justice is a movement of struggle; like any other social movement, like the civil rights movement. For many, it's hard to see that compromise. But when you live in disadvantaged communities, we saw those brick walls being put up by people not being willing to compromise. And the way we compromise is, we create the conditions for greater participation." When Roberto says "participation" here, he's referring not only to fellow community members, but to the whole spectrum of potential partners and allies beyond. Comite Civico's role is not just to represent, but also to self-position, relate to, and articulate with others (Choy 2011). For example, he's learned to prioritize language that is legible to more powerful actors, even if it takes some convincing on the community side. "Citizen science" is an unpopular term in immigrant communities because of the sensitivity around citizenship status, and so many projects are called "civic science" instead. Comite Civico, however, maintains the former term because it's more recognizable to state government and academic partners.

Similarly, Roberto relates how he prepared for his first experience organizing for a public hearing by following his models, Cesar Chavez and Martin Luther King, Jr.: "we showed up, and we spoke loud!" When one of the Board members dismissed the group as "just emotional," he switched tactics, and began to advocate "with evidence versus emotion." In either case, the goal is clear: the advocacy Imperial's communities need most is the advocacy that works best.

Telling and Negotiating

The night before the public hearing in Sacramento, our group prepared our statements together in the lobby of our hotel. Roberto is the most careful, going through his remarks with Alicia (a San Diego-based community organizer) to make sure that every statement is followed by evidence, and that his more pointed comments about the County's history of ignoring disadvantaged communities are strongly worded, but not spiteful. He confirms with Alicia that he plans to wear a navy suit with a white shirt, and I realize that I've never seen him wear anything other than a crisp, restrained suit.

The next morning at breakfast, Roberto and John are glued to their phones. Apparently, there has been a rather seismic shift in agency alliances since we last talked. Imperial County and IID had been expected to speak against and even blame each other in front of the State Water Resources Control Board; in short, each agency had previously stated that cleaning up the Salton Sea was the other's responsibility. Instead, they had changed tactics and decided to present a united local front organized around an appeal to the state on behalf of community-driven priorities like public health and environmental justice. Roberto and John think this is absolutely absurd. "These people don't even know what environmental justice means!" John says, rolling

his eyes. “But they heard we brought five people up from Imperial, and we met with EPA and with people in the Capitol [yesterday], and now all of the sudden they’re inviting us to a ‘strategy breakfast’ [before the hearing].”

Roberto had considered accepting the invitation to breakfast - he generally prefers being in the room, given the option - but agrees that this is yet another case of turning environmental justice organizations and Latino activists into poster children. “These are issues that I would have hoped to be involved with years ago,” he explains, “but we’re never invited to the table until there’s a crisis.” It’s the same treatment they’ve received from mainstream environmental groups. “I get invited to tell the story of my community, but I don’t get to *negotiate* it as well. And that’s what these groups believe, that the Spanish communities can’t represent themselves, so you’re just gonna invite them and display them, but then negotiate *for* them.”

Illustration 4.5: Representing ourselves. En route to a meeting, members of Comite Civico stop to examine the Imperial County display in the California State Capital. Roberto notes that it is by far the least detailed display. “The only thing they got right is the dust!” he jokes.

In this case, however, he sees this predictable pattern of exclusion as empowering their negotiating position. Imperial County clearly doesn’t care about environmental health or justice; if they did, Roberto and his fellow organizers wouldn’t be fighting for them to provide the minimum amount of environmental regulation required by law. Instead, he believes they’re

threatened by Comite Civico's decision to subvert the normal governmental hierarchy by going over the heads of County and Irrigation District authorities, and speaking directly to the state agencies based in Sacramento. Imperial's agencies want to protect themselves from exposure and oversight, he says; they don't want to be transparent, and they don't want to be accountable. By simply practicing visible, professionalized, well-targeted civic engagement - conducting their own strategy sessions with their EPA partners and their local Representative the day before delivering statements at a public hearing - Comite Civico had effectively demonstrated their ability to negotiate on their own behalf, and perhaps, if John's suspicions are correct, even forced a reframing of the conversation about what kind of disaster the Salton Sea had become (although that conversation was still dominated by IID and Imperial County). More than simply escalating their complaints up the chain of command, Comite Civico was engaged in a remaking of the scales and structures of governance around the specific concerns of their communities.

Saving

The first thing you notice about Laguna Salada is its size, the sheer *enormity* of this dried up lake just a few hours south of the Salton Sea. Here, heat pours over playa that stretches for nearly 40 miles, the flattened sediments broken up by dead sticks, tire tracks, and at least one ad-hoc landing strip. Our little caravan of cars follows the tracks for a few miles - tiny signs indicate an established path across the playa, though I'd hardly call it a road - before breaking off to begin surveying the area. Stepping out of the car and in to the late autumn sun, I'm greeted by the familiar quiet of the desert. Laguna Salada feels so much bigger for its emptiness: no sound, no landmarks, just *nothing*.

Despite its location 100 miles south and across the U.S./Mexico border, Laguna Salada occupies a critical space, both geographically and symbolically, in many advocates' plans for the future of the Salton Sea. Today, I'm touring the playa alongside a dozen activists and friends of Enviromedia, an environmental education and arts-focused non-profit based in Salton City. Enviromedia is a relatively new addition to the complex and often over-crowded field of Salton Sea advocates. Since its founding in 2011 by a group of artists and public relations gurus, its primary focus has been the "Save Our Sea" campaign. This campaign promotes a large-scale redemptive vision of the Salton Sea as an environmental utopia, one sustained by renewable energy generation and low-impact recreation, and supported by a massive infrastructural project: diverting water overland from the Sea of Cortez, through (and potentially filling) Laguna Salada, and across the border to the Salton Sea. The cornerstone of this campaign is an event they're calling the "Sea to Sea Walk," in which a team of activists, filmmakers, and drones will trace the path of this water from Laguna Salada to the southern shores of the Salton Sea, traveling on foot as much as possible.[14] This trip is part scouting mission, part investigation into the power of direct experience of a place for inspiring activism. Much of our time over the next two days will be spent producing a specific visual politics of place: staging dramatic photos of activists walking along the playa, recording video diaries describing our personal connection to the Salton Sea and what it's like to see Laguna Salada in person, and testing out a drone Enviromedia will use to document the official Walk.

[14] This was not a unique idea. "Following the water" constitutes its own sub-genre of environmental activism, whether framed as endurance test, awareness raising, performance art, pilgrimage, or some combination thereof. During the three-year period of my fieldwork alone, I am aware of at least five separate projects physically tracing the movement of Southern California water and water infrastructure.

As we begin to orient ourselves on the endless playa, Casey, Enviromedia's young founder and our guide for the weekend, directs our attention. "This is what it would look like if the Salton

Illustration 4.6: Documenting the journey. Enviromedia team members and allies orient themselves on Laguna Salada, matching up features on a map and attempting to judge the distance to the other side of the playa. The process is filmed by Enviromedia and by a camera crew producing a documentary short for Al Jazeera.

Sea dried up," he says, projecting the potential future of another place on to the landscape in front of us: exposed toxic playa (although Laguna Salada, unlike the Salton Sea, was never an agricultural sump), fish dying and birds flying elsewhere, entire communities drying up. We've all heard these dire predictions, but it's another experience to see some of them "realized" here, in a place considered to be the Salton Sea's sister desert salt lake. Bob, a retired merchant marine who moved to Mazatlán to stretch his pension, sketches in a few details. There was water here for fishing as recently as the 1970s, but, on his last visit to scout the water route himself, his

horse could barely find enough to drink. The water that used to flow in to the lake has been diverted elsewhere ("well, that sounds familiar," grumbles one of the other activists). Our photographer, Nina, crouches down to take photos of the distant horizon from the ground, saying "you can really see how everything dies." With confidence and polish honed in his previous career as a public relations guru, Casey encourages us to focus on the potential of these two Seas, not just their desolation. This is not just about addressing immediate ecosystem and health concerns. It is also about longterm dreams for what these two Seas could become, if we (the caring but distantly located viewers hailed by his message) can divert enough momentum, resources, and political will.

Advocacy from a Distance

Something about the Salton Sea seems to invite these large-scale narratives of salvation and destruction. In California's already overwritten water history, it occupies a place alongside Owens Valley and Mono Lake; a powerful symbol of envirotechnical hubris that is either a redemption story in the making, or a toxic wasteland already past the point of repair. Enviromedia's efforts to save the Sea are thus part of a trend that can be traced back at least to the 1980s, when an earlier version of the "sea to sea" idea first began circulating among activists and local water managers.[15] Today, most Californians know the Salton Sea area not as Roberto and Comite Civico know it, as a place where a diverse group of people live and work, but as an aesthetic disaster landscape: a site of photogenic suburban ruins, strange outsider art, and transient alternative communities. While the previous section showed one set of strategies for

[15] Of course, reactions to it at that time were so immediately negative that few older activists today are willing to entertain any version of it at all.

resisting this erasure - the casting of the Salton Sea by locals as a health and environmental justice problem - this section shows another - the projection of large-scale ecological hopes and dreams by outsiders who view the Sea as a place they can save. But, and following the idea of emplaced advocacy, what does it mean to care for a broken ecosystem from afar? For Enviromedia and others like them, the Salton Sea becomes a place they can't (or don't want to) live in, but nonetheless come to think of themselves as local *to*.

On one hand, it is easy to critique the politics of projects like this, particularly here. The history of California's desert lands is full of settler colonialist projections of ideal forms of life onto spaces evacuated of the people, places, and things already there, making any attempt to impose meaning from a distance a sensitive issue at best. On the other, the Sea to Sea idea is not without local support, and, given that *any* substantial mitigation or restoration effort for the Sea will require a large mobilization of resources over a relatively short period of time, there is certainly a practical argument for marshaling allies by any means necessary. Factoring in the imminent disaster context, these outsider activists are not unlike Fortun's activists caught in a double bind, where individuals must choose between multiple equally important, but incompatible obligations, while also gesturing towards the constant urgency driving the need to make a decision. Enunciatory communities emerge through responding to this sense of urgency, where existing explanatory models fail to match up to everyday life, and individuals are forced to reimagine new ways of engaging and new explanations. As the Sea to Sea plan travels beyond the local, it serves also as a way of reminding water experts in urban centers that California still has big water problems, which may still require old-fashioned big ideas like large-scale

importation, rather than simply efficiency, sustainability, and conservation. In other words, perhaps the state is in need of one last "big water project."

A Beautiful and Dangerous Place

A week after we return from Laguna Salada, Vincent and I spend six hours sitting in the dirt near the edge of the Salton Sea, staring at a piece of clear plastic tubing attached to a small pump that clicks, sputters, and hums along as he adjusts the dials. The other end of the tubing snakes down in to the ground, down a recently bored hole that (according to Vincent's GIS data, at least) should provide access to the local groundwater system. If this test goes according to plan, he will recommend that the site be developed into a monitoring well for a regional survey of baseline environmental conditions on the western side of the Sea.

Vincent is a young field biologist from San Diego, who splits his time between this job, with a local ecological restoration firm, and his para-professional gig as the lead biologist for Ecomedia. He didn't really know anything about the Salton Sea until he met Casey, who is now his partner, and got caught up in the latter's infectious enthusiasm for it. Vincent and Casey even moved to Salton City recently to be closer to Enviromedia's headquarters, although Casey still commutes to Fullerton for school or to Huntington Beach to visit his family at least once a week. As Vincent troubleshoots the reluctant water pump, we talk about his experiences with Ecomedia's earlier work.

Part of the goal, says Vincent, is to show the beauty of the Sea and its potential, not just the photos of run down buildings that everyone else shows. He reminds me of a fundraising event I helped with a few months ago at the North Shore Yacht Club, where we sold photos and

paintings of the Sea in exchange for donations. Throughout the day, people kept referring to the beauty of the Sea, gesturing to the view through the Club's wall of windows with no further explanation. That beauty simply *is,* they implied, and something about the bare truth of that is justification for the protection, love, and stewardship of the Sea. Of course, it's not always so easy to match aesthetics, firsthand experience, and desired political action. I also remember selling a framed photograph to a couple who had recently moved to the desert from Massachusetts, and couldn't wrap their heads around how the Sea could be beautiful and dangerous at the same time. Why had Casey talked so enthusiastically about kayaking and swimming in it, if the water is so dangerous that it also kills fish and barnacles and poses a major threat to air quality? They were unable to reconcile what they'd been told about the Sea's danger with what they were seeing in front of them.

While the focus on art and music is what makes Enviromedia unique, their current political platform is promotion of the Sea to Sea plan. Vincent describes how they first learned of it by interviewing local residents and developers; everyone had heard of it, but everyone also brushed it off as an old, unrealistic idea that was too expensive to be feasible. And yet, after talking to a desalination and geothermal technology developer, it began to seem not only possible, but practical. "He had a desalination plant already here and working," explains Vincent, "and he basically drove home the point that desal along that route [for transporting water from Sea to Sea] would be cheaper than it is on the coast because you can plug it in to the geothermal here. And we were like, ok, that makes sense!" Moreover, compared to contemporary plans backed by the Salton Sea Authority, one of which would shrink the Sea by roughly 90%, the Sea to Sea plan

was “one of the plans that seems more productive and most wanting to actually conserve or restore the sea,” rather than manage it out of existence.

Ecotopias, Big and Small

While Vincent and Casey were convinced by a practical, if ambitious solution, others responded to the discourse of abandonment and hopelessness surrounding the Salton Sea by proposing to rebuild it from the ground up. Bob, the Mazatlán-based retiree, is one such dreamer. His plan, which he refers to simply as “The Project” in a way that makes the capital letters apparent even when spoken, is pure California utopia. The Project is based on a pair of city-sized intentional communities on either side of the U.S./Mexico border - what is now the impoverished and largely agricultural Calexico-Mexicali Valley - connected by a canal drawing water from the Sea of Cortez to the Salton Sea. In a return to the 1980s iteration of the Sea to Sea idea, Bob’s canal system would be large enough to support freight transport and cruise ships, effectively making the communities around the Salton Sea into international port towns. But water is only the beginning. Bob is building the world he wishes his children had been able to grow up in, and he has a plan for every interlocking component, from collective farming to job-oriented education to affordable housing. His pitch is smooth and practiced, punctuated by a politician’s hand gestures. “If you create a canal, how does it survive? If you create a town, how does it survive? Who provides the food? Who provides housing? Who provides infrastructure? Who provides authorities? Who provides the things to keep it *centered*? And it took everything. That’s why I say this project *requires* everything, because everything has to be taken into consideration.”

Bob even brought his laptop to Laguna Salada to show us the enormous amount of data he's produced to demonstrate The Project's feasibility: maps, business plans, land assessments, community guidelines. This preponderance of information is, is his eyes, a rebuttal to those who accuse him of being an unrealistic dreamer. He says, "Billions over the last 50 years have been spent on California water projects. This Project is a tenth of what's been spent over the last 50 years, and none of that has worked. Unrealistic projects are a whole lot about politics and people adding money to this and that and never getting this job done. You need to make it realistic." That is, Bob's Project is realistic because it is transparent, sincere, and free of corruption, unlike what's come before. If Casey's rallying cry is "just add water!" Bob's is "just go fix it!"

To say that other activists approach The Project with some skepticism would be a gross understatement. The Salton Sea has been defined by and through the incredible accumulation of proposals to save it for at least 30 years, and most advocates and resource managers involved with the area express at least a little "plan fatigue." Within the broader California water world, it's earned a reputation as the water manager's Kobayashi Maru; a no-win scenario that every new cohort tries, but none actually solves. Given its continued appeal to water problem solvers, it's perhaps unsurprising that the Salton Sea continues to inspire the kind of big infrastructure projects and ecological transformations that have gone out of fashion since the Progressive Era. Casey and Vincent are quick to point out the many impracticalities in Bob's proposal, yet they have their own version of a Salton Sea utopia as well. As Vincent says when I ask him to predict what the area will look like 50 years from now,

> I'm gonna project my hopes on to it. I've always thought of the word 'ecotopia' for this area because it has the *maximum potential* to be an ecotopia. It has the possibility to use renewable energy, in conjunction with habitat conservation, and

> new cities being built. But, I think cities need to be built in a different way. I think we need to start looking at where cities *are* and protect the environment they're *in*, build for *that environment*. We have a tendency to just build cookie cutter homes everywhere and I don't think that's smart and efficient. But yeah, I think it has all the potential to become California's - if not the nation's - renewable energy mecca. And a place that kind of integrates technology with the environment, with recreation, and with economy. It's all here! But a lot of people don't see it, and you kind of have to have a little bit of an imagination, and a little bit of courage to envision it. It's all there.

Stakeholders

Thomas is running out of patience. A retired economist with decades of experience in water management back in the eastern United States, and a few years on the Smoketree Water District Board here, he cannot understand why the Smoketree Water Stakeholders' Coalition (SWSC) hasn't accomplished more in the two years since its inception. His exasperation is understandable. I've observed the SWSC's closed-door meetings for much of the last year, a privilege only extended to me after multiple assurances that I would not transcribe the sensitive conversations within. Their tone can best be described as slow and careful: careful not to offend, careful not to name names or numbers, and, perhaps most frustrating, careful not to disclose or extend any more than absolutely necessary to keep the process moving forward, albeit slowly. Thomas has had to rehash the same technical details about groundwater modeling, procedures for the Smoketree Water District (SWD), and the increasingly complex timeline for the new Sustainable Groundwater Management Act (SGMA) at most of these meetings. Perhaps, he jokes, those questions come up again and again on purpose to delay the process. And yet, there is something sincere beneath the joke: Thomas wonders whether the problem is that not enough

people know how to be an effective stakeholder, which could easily leave the process as a whole vulnerable to those who seek to exploit that ignorance and indecision.

Part of this fuzziness in roles was afforded by SGMA itself. Although the law defines what counts as an administering Groundwater Sustainability Agency (GSA; essentially, whichever agency or group has pre-existing jurisdiction over the region's water supply), there are no clear guidelines for who gets to be a stakeholder. Key audiences (both partners and stakeholders) for SGMA's outreach efforts are listed as state, federal, and tribal governments[16]; water and land management agencies and districts; NGOs and universities representing water, environmental, environmental justice, and agricultural interests; and, finally, "the public." This list is notable, although not remarkable, for conceptualizing participation in water management processes in terms of California's mandate to put water to "beneficial use" for people, the environment, particular kinds of production, and so on; that is, having a stake means being a user or recipient of water as a natural resource. Beyond these guidelines, however, water agencies are expected to follow their normal practices of giving notice to and receiving comments from the public, with any stakeholder working groups like the SWSC operating in an informal advisory role to the agency's board.

Thus, a disconnect emerges between the many roles that a stakeholder *could* be plugged in to within California's large-scale system of water management, and the difficulties, necessities, and shortcomings faced by people filling that role on the ground. In theory, requiring water

[16] That said, as one interlocutor working for a tribal council in eastern San Diego County explained, the rule of sovereignty means that tribes aren't actually required to participate in state-level water management processes like SGMA, even if they use groundwater. This created a situation that is, unfortunately, quite familiar for bands and tribes that are simply trying to protect their existing environmental rights: formally participating in the collaborative groundwater management process through SGMA felt like a concession of power, but not being "at the table" at all could lead to them being forgotten by other groups capable of working against their interests.

agencies to incorporate standardized participation and recognition as stakeholders allows communities more direct access to how their water is managed, and perhaps a more truly collaborative process of doing so. In practice, however, the figure of the stakeholder becomes more of a flexible relational category; embedded within locally-specific contexts, and taking on whatever identities and ideologies its users project on to it. In Smoketree, as elsewhere, discourse on who is or should be a stakeholder is really discourse about who is recognized as *having a stake* in the community, its water, and its future; who is entitled to advocate on behalf of that stake; and who can gain recognition from those with power over the process.

A Seat at the Table

The stakeholder model of public engagement is a relatively recent addition to California's water policy milieu, gaining traction in the 1980s as part of the increasing professionalization of "public engagement" within water agencies, and becoming part of a broader shift towards decentralization and regionalism in the 1990s (Hanak et al 2011). Much has been written on the problems of organizing public participation on environmental matters of concern around "stakeholders," both within California and elsewhere in the United States. From a public policy perspective, the standard narrative of intractable interest-group politics may have a structural cause, where decentralizing environmental management has created "many responsive but narrowly focused stakeholders" (Hanak et al 2011, 7). From an ethnographic perspective, however, the greater impediment may be the assumptions built in to the stakeholder model itself, where stakeholder status is articulated in terms of interest groups making rational, measured decisions based on trade-offs between commensurable alternatives. As Espeland explains in her

sociological study, “In conceiving of politics as decision making, in framing political participation as people's having preferences and values they care about maximizing, and in understanding and creating political units on the basis of models of rational individual actors… our conceptions of rationality elicit and reinforce interest-group politics” (Espeland 1998, 32). These assumptions are built in to every stage of the stakeholder process, from how the process is framed, to who is invited (or not invited) to the table, to how they define and perceive their own and others’ actions once they’re there.

The SWSC is a product of the Smoketree Water District’s Board (and, particularly, their frustration with an updated groundwater sustainability plan that was already many years overdue and had become mired in local politics) and a sympathetic ally at California’s Department of Water Resources (DWR). The Board sought to restart what seemed to be a broken process by convening a series of closed-door listening sessions with the town’s major water users and “opinion leaders” (as defined by the Board and DWR), hosted by DWR as a trustworthy outsider, and led by a professional facilitator from a partnering policy research institute at CSU Sacramento.[17] In trying to distinguish the SWSC from the SWD, the former was also conceptualized as a less technical space open to community representatives who had not, historically, participated in discussions on water, but nonetheless had some kind of stake in the town’s future: the head of the Chamber of Commerce, teachers from Smoketree Springs School District, and so on.[18] This original group of community leaders and significant water users then

[17] This last step was critical for success. The facilitator’s role was to impose and enforce a framework based on rationality and commensurability, where agreeing upon ground rules, crafting a group mission statement, and speaking in the carefully bland vernacular of consensus-based mediation would (theoretically) neutralize existing conflicts and power differentials just enough to get things done “in the room.”

[18] While the conveners saw this as a move towards inclusivity for local businesses and families, respectively, the specific invitees were of course still chosen based on their ability to participate in a labor-intensive working group that met regularly for 4-6 hours on a weekday.

gradually became an advisory working group for the town's groundwater sustainability plan; both the official stakeholders' organization partnering with the SWD, and later the public's semi-official representation in the SGMA process.

Being in the Room

There was, of course, widespread controversy over who was and was not allowed "in the room," much of it driven by the kinds of interpersonal conflicts that enliven any small town. During the first year of my fieldwork, while the SWSC was still struggling to build trust and speak the same language, Thomas bemoaned that stakeholder status had been based on narrowly-defined interests or representational politics that bring one to the table in the first place, rather than responsibilities for what you do once you're there. "Part of the problem," he explained, "is this California mentality, where a stakeholder is whoever is willing to show up." Stakeholders, in his view, should be experts, the people most qualified to shepherd a highly technical process required to meet certain standards of credibility. "There are a lot of major players in water here in Smoketree who aren't on the SWD board and aren't in the room [for the SWSC]," he said, sighing, "and there's really no reason why they aren't other than this stakeholder model." Thomas has a reputation for being a bit academic - his spontaneous technical lectures during SWD Board meetings are well known - but in this case, his concerns were about more than simply wanting to work with like-minded people. Meeting the legal requirements for SGMA carries (at least) a one million dollar price tag for Smoketree, as well as an urgent timeline. From his perspective, choosing not to enroll any and all local experts as key stakeholders in the process seemed plainly irresponsible.

At the same time, and to other members of the group, his continued insistence that there should be a certain knowledge-based barrier to entry seemed antithetical to the entire idea of a stakeholders' coalition. Members like Carolyn, the superintendent for Smoketree Springs State Park, and Anne, the president of the local high school, saw themselves as having the privilege and responsibility to speak for those who couldn't be in the room themselves: the surrounding ecosystem, and the largely Hispanic population of working families with children, respectively. For them, as for Fortun's white middle-class activists (2001), being a stakeholder meant being a fortuitously positioned advocate at a critical moment, not a neutral conduit for expert knowledge. Anne, for example, would often interrupt technical discussions to people the water system, asking how high the water bill would soar for a student's parents' restaurant in town, or reminding hard-line environmentalists that the local farms and golf courses also provide predictable jobs, and the green park in the center of town is the only free, public space for parents to bring energetic small children. Explaining her motivations, she says, "We use 'community' in a big sense, but there are no Hispanic folks in the room. We need to connect with the parts of the community that are disjointed [from those in the room], we have to be connected with those people to have a sense of place." Defining who gets to speak on behalf of the community inevitably involves defining the community itself: who is in it, who matters, and which characteristics of life in Smoketree should be represented as the values and characteristics of its stakeholders.

Having a Stake

From outside of the room, however, the position of stakeholder seems even more symbolically loaded for its inaccessibility; raising questions of who is entitled to have a stake in a particular place, and whether some stakes count more than others. Although the SWSC maintained a public website with a log of (anonymized) minutes, its meetings were still held behind closed doors. This struck many in the community as odd, or even nefarious - every other group purporting to represent the public held meetings that were open to them - but those familiar with Smoketree's history of secrecy and backdoor power-brokering weren't surprised.

There's a hiddenness to the daily functioning of small, unincorporated towns; the ways in which community politics and powerful individuals fill the space of governance that would otherwise be filled by municipal-scale structures like city councils. This is, in part, by design: Smoketree's history is that of a company town run by three powerful agricultural families[19] through the early 20th century, and then developed by rich industrialists wanting a remote desert playground with low tax rates. Today, the distinction between public and private blurs. While public officials like the members of the SWD Board are subject to California's Brown Act, which severely restricts the kinds of public business that can be conducted out of the public's eye, less official community representatives like the head of the Chamber of Commerce are not. Governance is an ad hoc affair, with a proliferation of personality-driven, overlapping community organizations sometimes working at odds to or duplicating each others' projects.[20]

---

[19] So powerful is this legacy that some "unflattering" aspects of local history, such as Cesar Chavez organizing one family's workers for the United Farm Workers of America, are still glossed over in the town's "official" community history books.

[20] One example: due to a professional conflict that turned personal over ten years ago, Smoketree now has two different natural history associations in competition for members, donations, and programming.

Surreptitiously forwarded and blind carbon copied emails wind through networks of year-round residents, seasonal snowbirds, and outsiders, collecting news and gossip while disrupting insider/outsider divisions. As Lara, a retired development officer from Los Angeles, explains "Our default mode of governance here is doing things without consulting anyone else. No one is looking at the entire Valley in terms of what projects are coming down the pipeline. Our County Supervisor has a martini with someone from Smoketree, and suddenly we're getting a seven million dollar library that nobody asked for!" Janet, a local substitute teacher and occasional consultant for the Water District, is more succinct. "*Pueblo chico, infierno grande*," she sighs. "Small town, big hell!"

That said, the promising aspect of a town based on unofficial labor and authority, as least for many members of the SWSC, is its promotion of a culture of volunteerism. In the absence of significant financial resources or political capital, community organizations instead rely on human resources and a spirit of advocacy; the idea that, as Anne puts it, many retired people move to Smoketree because it feels like the kind of ideal small town where people really do want to help each other out: "we've done other things with our lives, and now we want to be *of service*." While there is real danger in the capacity for volunteer labor to conceal or erase the true cost of keeping the town running, it is also a significant asset. For example, Nadine, the president of the Water District Board, capitalized on this self-image by encouraging homeowners to voluntarily conserve water during the drought, and promoting the fact that neither the Board members nor the SWSC drew salaries for their work on behalf of the town. Her speeches to this effect were sincere and often quite moving, separating rural small town Smoketree from urban environments where residents simply don't care enough to act on their beliefs in the same way.

But, they also came from a shrewd recognition that the SWD simply didn't have the resources to enforce the state's drought-mandated conservation measures the way that large urban agencies could, or to design a new groundwater sustainability plan without significant assistance from self-appointed advocates who saw themselves as having a real stake in the process.

Conclusion

In this chapter, I have traced the lived topology of four stories of emplaced advocacy. First, I followed aging conservationists living in small, rural towns along the U.S./Mexico border as they meticulously gather research that allows them to confront developers that would treat them as sacrifice zones for the benefit of distant, more affluent cities. Next, I moved to the Salton Sea, for a pair of stories on resisting the erasure of specific people and forms of life within a disaster ecology. The former showed how civic engagement becomes a way of building networks of powerful partners, and articulating locally meaningful forms of community organizing and restorative justice for disadvantaged communities living near the Sea. The latter moves outward to consider those who care for the Sea from afar, and seek to save it with new visual narratives and big water projects. Last, I returned to fundamental questions of local water politics by considering the differences between stakeholders and the public, and what it means to have a stake in Smoketree's future. Along the way, I have attended to the politics of self-selection, participation, recognition, and refusal in each of these places, including how participation is coordinated and negotiated within small communities, regional networks, and broader scales of governance.

In some ways, these stories are a fairly representative cross-section of what environmental advocacy look like across water worlds, regardless of specific context. The framing of water as a particular kind of problem, and of water itself according to a particular set of interests and values, also frames the acceptable and legible forms of engagement in response. Environmental and technological breakdowns reveal the differential distribution of problems that were there all along: lack of resources, environmental injustice, crumbling infrastructure, and barriers to civic representation and participation. Responses are urgently needed, but unavoidably incomplete and imperfect; some forms of privilege and exclusion can be redressed, while others are reproduced. Hope and optimism persist; sometimes in the form of continued small practices, and sometimes in large-scale utopian visions of how the world might be otherwise. And yet, the specific details are critical. Beginning from the assumption that these forms of advocacy are, in fact, deeply emplaced reveals how different individuals and groups figure their specific relationships of care and belonging to a place *through* advocacy; through enrolling water and other environmental objects in to entire activist ecologies of practice.

SPRING: WILDFLOWERS

Every March, like clockwork, the annual watch for wildflowers kicks off across the low desert. “Wildflower hotlines” and maps are updated, sometimes daily; businesses overstock their shelves for the coming tourists; and locals speak hesitantly through an array of code words and jokes around talking (or avoiding talking) about the coming bloom.

In spring, more than any other time, it feels a bit silly to call the desert “extreme.” Rafael, a field biologist who studies flowering plants across the Sonoran Desert, has a particular bone to pick with this anthropocentric terminology. Speaking from the perspective of the plants and non-human animals that also inhabit these places, he prefers the terms “sensitive” or “responsive.” The point is that all environments have their own set of norms, he explains, and plants and animals are connected to a place through their responses to those norms. During one of our many conversations on this topic, I decide that I prefer the term “opportunistic.” The spring wildflowers are opportunistic survivors to be sure, but so are the people that depend on them.

Of course, the desert doesn’t always cooperate. A good flower year requires steady, consistent rain throughout the winter, soaking seeds that lay dormant, sometimes for years or decades, waiting for the right conditions. It can’t be too hot or too cold, neither too soon nor too late. Everyone seems to have a story of a year when the conditions seemed perfect, but, for some mysterious reason, the flowers didn’t come. There is a superstition about acknowledging this possibility: better to deflect with the multiplicity of uncertainties involved in a good flower year, than acknowledge a bad one might happen.

The presence or absence of certain flowers becomes a way of marking time. During my first spring in the desert, a severe drought year that didn't make for a particularly good bloom, I happily documented a flowering indigo bush, its deep purple curled petals a shocking splash of color against the tan desert. I showed the pictures to Leo, a local biologist at Smoketree's field station, who viewed them with concern. "It's blooming at least two months early," he says, furrowing his brow. "That's the graduation flower, it usually blooms in May when the kids get out of school. There's another purple flower around here that doesn't usually bloom until summer. Everything's happening too early."

The stakes are higher than mere aesthetics. Tourism has become a way to sustain the economies of small towns that can no longer rely only on their residents, and dramatic wildflower blooms can attract hundreds of thousands of visitors annually. The anticipation and expectation build with every dry year, until it feels like the entire town is watching the wet season fail to appear, hoping for a break from the relentless years of environmental and financial drought. As with any small, isolated place, however, the presence of (and intense dependency on) outsiders is a double-edged sword. Asking locals about flower conditions when you've lived there long enough to know better is a good way to make people stop talking to you.

And yet, that uncertainty is what makes a desert bloom so charismatic. This is the desert at its most accessible and most green; at the other end of the cycle from summer's unrelenting heat. But flowers, like everything else that is green in the desert, are ephemeral. Almost overnight, the sandy washes at the sides of roads and the bases of canyons spring up with color: leafy green and white desert primrose, bright yellow desert sunflowers with tall stalks, and tiny purple sand verbena. "Blink and you'll miss them!" says Sam, the park ranger. But just as quickly, neon

green Sphinx Moth caterpillars appear, devouring whole fields of flowers in their wake as they emerge hungry from under the ground, buoyed like everything else by rain and the heady days of spring. Sam tells me the caterpillars seem to be moving east, and I imagine whole battalions of them sweeping across roads and fields, visible against the asphalt as a shimmering wave of bodies. That year, a news outlet in San Diego claims that caterpillars, and not flowers, have actually caused traffic accidents. And after that, the Swainson's Hawks will appear to feed on the caterpillars, and the summer heat will bake the desert back to what we think of as its normal state.

Every year, Leo tells me the same story about wildflowers, and the danger of putting too much stock in their appearance. Once, years ago, he was booked by the Park to give a wildflower tour. People signed up for it months in advance, expecting to spend the morning identifying a rainbow of blooms with a trained biologist. But then the day came, and it had been a dry winter, and there were no flowers to be found. Right before the group gave up and returned to their cars, Leo spotted one verbena flower. But, he also spotted a sphinx caterpillar on the plant, inching slowly towards the petals. He yelled for everyone to hurry up - "come look at the flower!" - and they watched the caterpillar eat it in a matter of minutes, the one flower on the whole flower tour.

CONCLUSION

In January of 2015, at the peak of the 2011-2017 drought, I sat in the audience of the yearly town hall meeting for the Smoketree Water District. Water meetings are big events in Southern California, and the turnout for the town hall is, accordingly, high - about 50 attendees for a 3,500-person town. The purpose of this year's meeting is to translate the local impacts of two state-level imperatives: the Sustainable Groundwater Management Act; and the "drought restrictions," an Executive Order mandating a 25% reduction in municipal water use. There are secondary priorities as well, like managing the persistent worry that the county and the state are steamrolling small communities for the benefit of coastal cities, and inspiring locals to band together and "take charge of our water future" in a time of great uncertainty and change. While most presentations stay within a technical register of quantification, water science, and risk management, the final comments by District Board President, Nadine, responded more directly to the anticipatory fear of daily life in a drying up town, in a place where everyone knows the water may not last longer than a generation. The real problem, Nadine suggests, is continuing to mobilize local concern for a place that is, realistically, too small to matter to anyone outside its borders. "As all of us know," she says, "the county's track record of cooperating with the community is less than stellar. But this time, it's in the county's best interests to coordinate with us. We'll work cooperatively with the state, too, but given the state's past unwillingness to fund Smoketree projects, our plan will provide for us to pay our own way. What's important is developing the unique vision [for our town], so there's *more than just water* in our future; there's the *preservation* of *this unique community*."

Two years later, in January of 2017, record-setting rains drenched California. Across the state, scientists and policy makers debated whether the state's historic drought was now finally, "officially" over, how, and for whom. And yet, on the ground, the impacts linger, along with fears that this reconfigured political and environmental terrain may be California's new normal under climate change. At its peak, drought discourse emphasized extremity and exceptionality. Emergency water management policies, with their heightened rhetorical tempo, allowed for critical work mobilizing resources for immediate conservation. Now, however, environmental leaders, water managers, and water scientists struggle with a more uncertain water world, and the potential for a radically different future. California has always been shaped by extremes, and the drought's full impact for its most exposed communities remains to be seen.

Much of this dissertation has been written from the perspective of the former moment, when the drought was at its worst, and otherwise normal, even mundane problems of water in the desert were suddenly heightened, solidified, and sped up by emergent drought rhetoric, policies, and infrastructure. Practitioners and activists alike had to reshuffle and prioritize their water problems, play up or play down drought impacts, untangle new rules and regulations, and advocate for their interests to the county and state in rapidly shifting technical language. Here, I shift to the latter perspective, scaling up and out to consider the complex, interrelated temporalities of groundwater scarcity, drought, and climate change as events. What really happened? And more to the point, what comes next? In Chapter Three, I showed how the idea of groundwater running out isn't really about the moment when the tap runs dry, it's about everything that comes before that moment; the fear of an entire town turning to dust. By the same token, the idea of a state of emergency for California's water and climate isn't really about

the moment when a notoriously unsustainable regime meets its extreme and final limit, it's about everything that comes after; the fear that these extremes driving new and different forms of precarity are now the new normal, and the after isn't really an "after," but a continuance (Valentine, Olson, and Battaglia 2012).

In closing, I offer a first glimpse at the emergent political ecology of extreme drought and water emergency in Southern California. Throughout my fieldwork, I encountered many moments of scalar gamesmanship like Nadine's comments above, as individuals and groups grappled with the significance of their water problem for a state in a drought and a world under climate change. In what follows, I discuss two debates over how to define a water problem, where scale is enacted and made meaningful through specific ecological relations. In these moments of disarticulation - where the data don't scale up or down, the timelines for action don't match up, or people discover they're not speaking the same language - it becomes possible to see the labor and partiality of ecology building in action. Based on the previous chapters' discussion of ecology building in the Southern California desert as seen from its small rural communities, I now scale my analysis up: who "speaks for" groundwater scarcity, drought, and climate change as events - for their causes and potential long-term impacts - particularly in the high-stakes policy and scientific spaces of California's envirotechnical regime? To return to the question I posed in the Introduction, when water experts, technicians, and activists call for new ways of living with water, or fight to preserve what is already in place, what (and whose) California are they attempting to sustain?

Water Problems

Throughout this dissertation, I have avoided referring to either groundwater or drought as "disasters," instead favoring the word "problem." This is a meaningful choice, and one that I make for two reasons. First, it reflects my interest in practices around the problematization of water, rather than the cause and effect of water disaster, and dovetails with my use of explanatory models. Second, and more importantly, the assumed spatiality and temporality of disaster simply don't fit with what I observed in the field.

There is a certain assumption of event-ness in studies of disaster. Anthropological work within this mode attempts to draw relationships between past (causes), present (difference, problem, crisis, or disaster), and future (mitigation, recovery, aftermath), demonstrating that not everyone (and everything) bears the effects of environmental changes equally. This dissertation is certainly written in conversation with that scholarship, and particularly with studies focused on long-term accumulation or spread of hazards like contamination and toxicity (Fortun 2001; Little 2013; Murphy 2006; Petryna 2003); on the creeping uncertainty of "slow" disasters like climate change (Hastrup 2013; Mead 1980; Miller 2006; Orlove 2005; Strauss and Orlove 2003); and on which forms of knowledge determine the parameters of what "counts" as a disaster or a risk and when (Choy 2011; Fortun 2001; Masco 2006; Ottinger 2013).

At the same time, water problems as I've documented them here might be both slow disasters *and* fast disasters; potential, not-yet-disasters or even normal, non-disasters. This is a subtle but crucial point, and illustrates what it means to consider California water not as an unfolding disaster in one place and time, but as a constellation of ecological relations built and rebuilt, problematized and manipulated at different spaces and times. In this sense, ecology

building shifts attention to specificity and significance rather than risk, hazard, or disaster; to the work involved in protecting or sustaining relations between particular people, places, and things, rather than the probability of losing them (Choy 2011; Masco 2006).

Keeping in mind that ecological relations do not assume scale, but enact it, I find it more productive to think of the California desert's ever-present water emergency in terms of extremes, where extreme defines both a limit and a horizon of outer spaces increasingly brought under the jurisdiction of human governance, both political and scientific (Helmreich 2012; Olson 2012). As field sites, such spaces of extremity raise the stakes of both technoscientific and anthropological attempts to apply expertise to the real world. As hypothetical or theory-making spaces and potential extensions of a human-centered cosmos, they reveal the ways in which human responsibility for natural objects and environmental spaces is also constituted as the continuance of particular forms of human life (Olson 2012). Given that the objective properties of water - its changeable nature, its movement, and so on - have "no meaning apart from human conceptions of [them]" (Helmreich 2011, 133), water both shapes and is shaped by our understanding of what constitutes an environmental problem in the making.

The View from Space

It's a warm night in April, and nearly 200 people have crowded into the modest Performing Arts Center in Smoketree Springs. They've come to see Jay Famiglietti, a hydrogeologist from the Jet Propulsion Laboratory (JPL) in Pasadena, and something of a celebrity scientist, give a talk on the latest and greatest drought science: groundwater monitoring with NASA's GRACE mission, the Gravity Recovery and Climate Experiment. The buzzing

crowd of citizen scientists, technicians, water managers, and local activists is remarkable in its own right. Helen sits to my left, and, after finding that I'm familiar with Jay's work, asks whether I think GRACE data could be used to support the EPA sole-source aquifer designation that prevents groundwater supplies from contamination. Thomas sits to my right, and is already copying down the citations at the bottom of Jay's opening slide, hoping that showing scientific figures with NASA's logo will help convince the drought nay-sayers at Water District meetings.

Falling into a practiced narrative, Jay explains that the GRACE satellites allow scientists to see and translate California's critical water problems across space and time in new and more definitive ways. "Snow and the rain come and go every year," he says, gesturing to a colorful graph with a number of downwardly trending lines, "but the groundwater just goes! GRACE allows us to say, this is when the drought began. This is how big it is; this is how much water we need to get back to normal conditions…The view from the ground is muddied by the politics. But, the view from space is clear and undeniable."

In the context of global climate change, desertification, and water scarcity, earth systems satellite missions provide powerful ways to imagine, visualize, and study large-scale, long-term environmental problems. These downward-thinking, visual narratives of problems "big enough to be seen from space" collapse local difference to implicate us all, while producing their own precision and objective authority in the process. But, what happens when these remotely sensed data are dragged down to what Jay calls the muddy politics on the ground, to a scale that is perhaps fundamentally at odds with their planetary perspective? If, as one engineer at JPL put it, these data are designed and produced to "work at the global scale," can people like Helen or Thomas try to make them work for specific, local situations? Here, I focus on what gets shuttled

in when water scientists frame groundwater depletion as a hidden drought; that is, as a problem that can be made visible through the application of particular scientific and technological practices; the view from space that makes certain dimensions or implications of drought visible in uniquely compelling ways.

Groundwater Plus Errors

Beginning with a September 2014 cover story for *Science* (provocatively titled "The Drought You Can't See") (McNutt 2014), and continuing with a series of viral op-eds written by Jay Famiglietti, NASA, the GRACE mission, and remotely sensed data in general suddenly became powerful actors in shaping public discourse on groundwater scarcity. I followed these developments alongside JPL water scientists and fellow drought researchers, as well as the practitioners and members of the public that those scientists imagined educating. Together, we watched as headlines about California's regional groundwater problem circulated alongside headlines about global or planetary or the Earth's groundwater problem, all referencing the same handful of earth systems satellite missions, and the same tables and maps.

The twin satellites of the GRACE mission were launched in early 2002 as part of NASA's Making Earth System Data Records for Use in Research Environments (MEASURES) Program. The twin satellites follow each other in near-polar orbit, about 200 kilometers apart. GRACE is not an optical satellite taking pictures. Instead, it functions like a "scale in the sky," tracking normal and extreme ranges of variation. The satellites measure monthly changes in the tug of Earth's gravity field, which are almost entirely caused by changes in the mass of Earth's water storage. These changes are then depicted in millimeters of equivalent water height, allowing the

data to show areas that are gaining or losing water on a monthly basis. These gains and losses are then rendered geographically to produce colorful maps, with red indicating increasing water loss and blue indicating gain.

But, GRACE data is only accurate to a region the size of Southern California; despite the absolute authority and precision implied by the map - and the stories linking California to the global - there is a limit to our ability to zoom in for greater resolution. There are also additional formalizing practices that become erased or elided by the final public product. GRACE indicates the total change in the amount of water stored in a region; not the type, origin, or behavior of that water. As David, a hydrologist based at Caltech, explained it, "there are really only four places that water can be: snow, surface water, soil moisture, and groundwater. Finding the change in groundwater requires you to calculate total water change minus snow change, minus surface water change, minus soil moisture change." That said, David is quick to point out that solving for groundwater isn't as precise or authoritative as it seems. While Jay takes great pains to distinguish GRACE's "clear and undeniable" view from space, that view is made meaningful by its interactions with a ground-based taxonomy of water and its attendant practices. Data gathered through direct observation of the ground and underground - most notably, DWR measurements of water table levels, which are gathered by sticking a measuring tape down a well - are combined with remotely sensed data on snow pack, and estimates on soil moisture to produce the final groundwater numbers. While Jay's explanation of the process emphasizes consistent objectivity and transparency, David draws instead on his own experiences as an applied geologist to offer a bit more skepticism. "Sometimes," he says "there are inconsistent time periods or

scales, or other things that can be compounded when you try to scale up. The end result isn't just groundwater; it's groundwater plus a lot of errors."

Zooming In

Viewed from the ground, the ways in which GRACE's accuracy or objectivity are activated result not so much from their veracity, as from values associated with the specific knowledge making practices through which they're produced. Helen wonders whether NASA's global expertise and trustworthiness will trump the subjective regionalism of California's EPA office. Thomas thinks the transparency of a federal governmental agency will convince people suspicious of secrecy in local politics. It's not that the view is from space; it's that the data rendered as visual narrative is somehow clear and undeniable.

The GRACE maps suggest that groundwater scarcity definitively exists at a superhuman scale, but they also collapse sociopolitical difference, erasing the ground-level data that local practitioners and activists find necessary for day to day problem solving (at the same time that it makes use of it in hidden calculations). That is to say, GRACE can't zoom in to the scale at which water governance actually occurs. We can see this scalar disconnect visually, but it's enacted also in the ways that data are produced, manipulated, and put to work, and in the ways that the relations between the view from space and the view from the ground are politicized. Thomas, in his day to day work, rests on the collective authority of an archive of ground-truthed data, insisting that the studies are conclusive because they are specific and particular. This data was meant to be emplaced, its partiality papered over by local explanatory models that everyone knows to be true. Jay and David, on the other hand, insist that the same archive is internally

inconsistent; not adequate for modeling or scaling up because there are too many potential errors to account for. The lack of comprehension and uniformity, and the inability to meaningfully scale up, make the data functionally incomplete.

We see in this example both connection and disconnection. The overnight popularity of GRACE in both scientific and mainstream media demonstrates a moment when remotely sensed data shaped the narrative of global and local groundwater scarcity as a particular kind of problem: big, objectively true, and requiring a technological, resource-intensive solution. And yet, that narrative has ultimately failed to fully articulate with the necessities of everyday groundwater problem solving, showing the failures of thinking water at a planetary scale. Of course, this begs the question: does it matter? Does it matter that the clear view from space is actually groundwater plus a lot of errors, or that the view from the ground is perhaps only useful for certain conversations in certain places? Does it matter that the two don't completely meet? On this point, Jay concedes the common ground of making *change* in groundwater visible, rather than simply the groundwater itself. "You could argue," he suggests to the crowd in Smoketree, "that you don't *need* to know, and the reason is that we're approaching groundwater from the top down. We already know we're past a critical point. It doesn't really matter if we have a million miles of water down there; the ground is already sinking, the streams are running dry. You could argue that it doesn't really matter."

The View from the Lab

A few weeks after Jay's lecture in Smoketree, I sit in a much more modern lecture hall on the UC Irvine campus for the American Geophysical Union's Chapman Conference on the

California drought. This time, I am surrounded by hundreds of scientists, researchers, and high level water practitioners from regional and state agencies. Despite the difference in audience, I am struck by the similarities between the two meetings: once again, the topic is the problematization of California water in light of continually escalating drought conditions; and once again, conversation centers on how (and whether) scientific data can usefully capture, define, and scale problems of water scarcity. This time, I am seated between Rafael, the field biologist based in the Sonoran Desert, and Claudia, a hydrologist working on groundwater modeling studies for USGS.

Amir AghaKouchak, a professor and environmental engineer, opens the meeting by calling for a discussion on whether the current drought is, in fact, a "new reality or a new normal" for California, and "whether the past is still a useful guidepost for the future." He asks the interdisciplinary crowd to embrace "a broad definition of drought as a condition in which demand for water exceeds available supply," a bit of boundary marking that will not strike me as particularly significant until later in the conference. The next speaker, Martin Hoerling from the National Oceanic and Atmospheric Administration (NOAA), continues with a quote by Alfred Clark: "About all that can definitely be said about the rainfall of Southern California is that it is meager and unpredictable." Noting that the room is full of scientists constructing early warning systems and drought models from big data, he hedges, "Well, some of you may bristle at that 'unpredictable.'"

Within California's envirotechnical regime, ecological processes like droughts – based on changing material conditions within a bounded system – become problems of technocratic water management that can be zoomed in or out, quantified, compiled, and archived. Droughts-as-data

can haunt predictive models as potential future crises; they can be prevented or managed before they even "occur," and they can fluctuate between meaningful categories like "exceptional disaster" or "new normal." And yet, within these practices, a basic methodological challenge emerges, reflected in the joke about rainfall's unpredictability: how are water experts, both scientists and practitioners, to characterize and operationalize future threats as something more than mere projected risks in scientific models on a computer? These models and information systems are designed to fill research gaps and contribute to basic science; as such, they are compiled and analyzed on timelines more in sync with statistically significant data trends and the flow of academic labor. Is it even possible, then, to put them to work on behalf of water agencies and practitioners, whose needs are determined by the cyclical, rapid timelines of policy implementation and fiscal years? Here, I highlight the disconnects that result when two differently scaled perspectives on California's continuing water and climate problems attempt to bridge that chasm.

Unpredictable and Undetectable

The first day of the conference features a roster of scientists characterizing contemporary drought and climate modeling efforts. Much of the material is familiar to those already involved in California's water world: the graphs of the state's large yearly variation in precipitation, which is dictated by the presence or absence of storms during a narrow seasonal window. The assertion that California is more sensitive to extremes, because our precipitation is not spread across temporal categories like it is elsewhere; instead, if something relatively small changes, it has the potential to wipe out the entire water system.

Rafael and I exchange glances between speakers. We've had many conversations over the years about the politics of applied research, and the strange tics scientists develop when translating their work for a public that is less interested in facts, and more interested in using a veneer of scientific objectivity to support their own pre-existing goals. During one of the breaks, he says he's noticed something that he doesn't quite know how to intellectualize. All of the speakers have started from the assumption that nature is wild and somewhat unpredictable, which he doesn't think anyone in the room would disagree with. But, it seems to him that all of the content we've just heard overemphasizes how much science struggles with that unpredictability. He has a point: many of the presenters seem to be carefully staying within the register of data interpretation, pattern recognition, and model parameters, building a case for scientific uncertainty for a crowd that doesn't need to be reminded of it. This is well known and agreed upon science, he says, packaged with far more caveats than it really needs. "Wait a minute," he jokes, "are we sure the drought is still happening? I'm not sure climate change is real anymore! There are so many *uncertainties!*" I wonder out loud if this is partially due to the media presence, which was explicitly noted in the form of a warning to "say only what you're comfortable having recorded" at the opening of the conference. Perhaps the speakers intended to emphasize the methods through which scientists verify that their results are good, but ended up lost in the processual weeds.

From another perspective, it's possible that, in bracketing off the scientific speakers from the practitioner ones, the conference organizers unintentionally framed a day-long discussion in which minute details of detectability, predictability, and repetition of patterns were used more to debate whether the drought actually exists *according to a given model* (something they could

discuss with one another), than whether a model could accurately represent hazardous conditions outside the lecture hall (a point on which they, presumably, already agreed). In other words, perhaps what went unacknowledged in this juxtaposition of talks was the assumption that everyone already knew the drought was still happening and climate change is still real, which effectively rescaled the discussion to a micro-level dissection of various models' merits within the scientific community.

Needless to say, the practitioners in the room, some of whom reminded the speakers that the objective of the conference was to enhance science-driven decision making, found this to be frustratingly narrow and self-indulgent. Eventually, Dennis Lettenmaier, a geographer presenting work on drought monitoring, begins to hint at the stakes of a scientific view from nowhere that speaks back to no one. Droughts are only relevant by comparison to some historical record, he explains. "That means we get into problems with new data sets from the last ten years, working into the long-term record of the past. And the 800-pound gorilla in the room is climate change. What if the historical record we're estimating our history relative to is changing? Our resampling method for historical time points only dates back to the 1976-77 drought; what happens when it's [a drought is] way outside the range of what can be predicted by the model? The real challenge for the forecasting community is, can you do any better than ESP?" During his own panel, Jay sighs, aligning himself with the practitioners in this setting, "science will always have a 'more research is needed' mentality."

Managed Systems

The next morning, I catch up with David Feldman, a professor of planning, policy, and design, who works on water systems in Los Angeles and Orange County. He is sympathetic to our practitioner colleagues; after all, we social scientists essentially work in the same space and at the same, human-oriented scale. He jokes that "today will be the day they talk about 'our' stuff." No more wading through overly technical, number-heavy scientific research; a series of scientists presenting dozens of graphs, and then insisting that what we need is more graphs. More people in the data.

As the attendees file in, I notice that the crowd has diminished in size, perhaps unsurprising for the portion of a largely academic conference more focused on research applications than basic science. And yet, I have seen these trends repeated over and over again across the California water world as dividing practices that effectively separate water science from water technology and water politics. Each group insists that the others should better adapt to the necessities and contingencies of their position, but few are willing (or able) to risk compromising the integrity of their information or their professional perspective to make that point of articulation work. These subtle cues within a complex terrain of knowledge politics do not go unremarked upon. Jeanine Jones, the fiercely outspoken Deputy Drought Manager for DWR, has structured her entire presentation on operational decision making around pointed reminders about the difference between, as she puts it, "things that are interesting, and things that are usable."

We have to remember, she begins, that the actions we take to respond to drought occur within a larger context. "One dry year isn't a drought because of our extensive water

management infrastructure," she explains. She includes the major reservoirs alongside precipitation and DWR's runoff forecasts as part of the system's "observed hydrology" that drives decision making, effectively chipping away at assumptions that scientific models of drought causation and temporality transition seamlessly to the space of day to day water management. And infrastructure is not just physical, but also social, legal, and economic. "What makes California more drought resilient than other states is funding like bonds, laws about water transfers, and participation from farmers in the IRWM process." Since these regulatory and other contexts can and do change over time, it's possible to have radically different impacts from the same basic hydrology. Thus, from the state government's perspective on California's water ecology, the meaningful difference is between unmanaged and managed systems, not between unpredictable and predictable ones. "We care more about the latter than the former," she explains, "The former is things like impacts to livestock or wildfire. These are things that the state can't control. We react to it, but we can't control it. We're very sensitive to things we can control through the tools we have."

This is not only an argument about pragmatic points of articulation between science, technology, and management, but also a reminder that water problems, unlike water data, cannot simply be scaled up and down. Instead, their scale emerges through impacts and possible responses. "Like politics, all drought is local. When I talk to general public agencies, we talk about how drought is defined. It's like the difference between recession and depression: recession is your neighbor loses his job, depression is you lose your job. It's about whose ox is gored." Water managers can't use a complex, globally scaled drought index operating on a decadal scale. In November, they need to know whether this water year will be wet or dry. In

January, they need to know whether the rest of the season will be wet or day. Her final slide features an antagonistic title taking aim at the question of who gets to claim authority for defining the problem: "And for the record, questions we aren't asking." "You know that old song, 'you don't need a weatherman to know which way the wind is blowing?'" she says. "Well, *we know* when a drought is happening, and when it's getting drier." It's less an issue of scaling knowledge down - although Jeanine does repeatedly remind the scientists in the audience that large-scale models and predictions are effectively useless within the small constraints of government work - and more about whether that knowledge, once scaled down, can articulate as locally meaningful expertise at all. Later in the day, John Leahigh, the Chief of DWR's State Water Project Operations Planning Office, responds to a similar question about whether his office, which manages one of the largest public water and power utilities in the world, thinks at the larger scale of long-range forecasting. "In my job, which is managing water day to day, month to month, I don't *see* climate change," he says. "There's a huge amount of variability. For this world I see, I don't use it [long-range forecasting]. I have to manage what I see."

Conclusion

There is an assumption in much mainstream discourse about environmental problems under climate change: that everything must be made scalable and universal in order to be useful for projects of sustainability, resilience, and disaster response. And yet, as my attention to practices of ecology building shows, this assumption belies the actual labor of articulating and building relations between and across scales; and the value of engaging the problem in ways characterized by their specificity, partiality, imperfection, and impermanence. As both a

theoretical framework and a "thing in the world," ecology building allows for a focus on what water does, affords, and could be; on what happens through and alongside the work of building, sustaining, or rejecting environmental relations.

Back at the Smoketree Water District's annual town hall, Nadine prioritizes the community's water management goals, while also suggesting that perhaps their greatest weakness - their isolation and extremity - is also a strength. "Droughts come and go, but conservation is forever. There will always be another drought, but we only have one aquifer." There's something quite complex in this simple carving apart of water. The drought may have brought Smoketree under the state's jurisdiction, but it (the drought) is too big and too ephemeral to worry over with their limited resources. They cannot control it, but they must keep it from controlling them in return. The Smoketree groundwater aquifer, on the other hand, is manageable. It is small enough to matter. More to the point, it is theirs to control, and its isolation from the rest of California's water system may someday make them the last place *with* water. In this sense, perhaps the ecology building documented here is ultimately about folk versions of California exceptionalism, steeped in a culture where environmental extremes as both limit and horizon generate entire ways of life (Valentine, Olson, and Battaglia 2012).

During one of my many long lunches with Jesse and William in Smoketree, the discussion turns to their perspectives on water and climate change. I am not particularly surprised when Jesse describes himself as someone who doesn't believe in global warming. "I think people should have contrasting opinions," he shrugs, "like I'm an environmentalist, and I don't believe in global warming that's caused by humans." But, he does believe in water sustainability. He figures he'll let other people fight over the big problems, like agricultural

irrigation. “It’s all about getting yourself to a point where you’re self-sustaining. To me, security is a ten million gallon, stainless steel drum of water in the backyard. Who cares about money? We’re in the desert, and what we need is water, and water is going to get more and more expensive. Money might not get you anything, but if you have water, you’ll be ok. That’s my retirement plan. That’s what I need to figure out.”

It’s not about running out of water; it’s about everything that might happen beforehand. It’s not about California’s already incipient new extreme; it’s about everything that might come after. Here, as elsewhere, talk about water bleeds in to talk about the role of applied science and technology, about activism and forms of governance, and about fears and hopes for the present and future of communities already on the edge. There is a real fear of the desert that emerges through water problems; an anthropocentric fear, where the slow processes of water depletion and desertification turn bios into geos on a long enough timescale. And yet, as others before me have written, there is something specific and particular - perhaps endemic in Choy’s terminology - about the California desert that makes it worthy of care, love, and labor. Living in the desert means carving a space for certain forms of human life in a place that is fundamentally not human-oriented, and that will always exceed our grasp; of continually building and rebuilding ecological relations at extremes.

REFERENCES

AghaKouchak, Amir, David Feldman, Martin Hoerling, Travis Huxman, and Jay Lund. 2015. "Recognize Anthropogenic Drought." *Nature* 524: 409-411.

Alatout, Samer. 2009. "Bringing Abundance into Environmental Politics: Constructing a Zionist Network of Abundance, Immigration, and Colonization." *Social Studies of Science* 39 (3): 363-394.

Alatout, Samer. 2010. "Water Multiple in Israeli Politics." Paper presented at Environmental Politics Workshop, Berkeley, October.

Armitage, Kevin. 2013. "The Soil Doctor: Hugh Hammond Bennett, Soil Conservation, and the Search for a Democratic Science." In *New Natures: Joining Environmental History with Science and Technology Studies,* edited by Dolly Jørgensen, Finne Arne Jørgensen and Sara B. Pritchard, 87–102. Pittsburgh: University of Pittsburgh Press.

Asdal, Kristin. 2011. "The Office: The Weakness of Numbers and the Production of Non-Authority." *Accounting, Organizations and Society* 36(2011): 1–9.

Auyero, Javier, and Debora Alejandra Swistun. 2009. *Flammable: Environmental Suffering in an Argentine Shantytown*. Oxford: Oxford University Press.

Bakker, Karen. 2012. "Water: Political, Biopolitical, Material." *Social Studies of Science* 42 (4): 616–623.

Bakker, Karen. 2014. "The Business of Water: Market Environmentalism in the Water Sector." *Annual Review of Environment and Resources* 39: 469-494.

Ballestero, Andrea. 2012. "Transparency Short-Circuited: Laughter and Numbers in Costa Rican Water Politics." *PoLAR: Political and Legal Anthropology Review* 35 (2): 223–241.

Ballestero, Andrea. 2014. "What is in a Percentage?: Calculation as the Poetic Translation of Human Rights." *Indiana Journal of Global Legal Studies* 21 (1): 27–53.

Ballestero, A. 2015. "The Ethics of a Formula: Calculating a Financial-Humanitarian Price for Water". *American Ethnologist* 42(2): 262-278.

Barclay, Bill, Janet Schmidt and Dick Hill. 1980. "State, Capital and Legitimation Crisis: Land and Water in California's Imperial Valley." *Contemporary Crises* 4 (1): 1-26.

Barnes, Jessica. 2012. “Pumping Possibility: Agricultural Expansion Through Desert Reclamation in Egypt.” *Social Studies of Science* 42 (4): 517–538.

Barnes, Jessica. 2013. “Water, Water Everywhere But Not a Drop to Drink: The False Promise of Virtual Water.” *Critique of Anthropology* 33 (4): 371–389.

Barnes, Jessica and Samer Alatout. 2012. “Water Worlds: Introduction to the Special Issue of Social Studies of Science.” *Social Studies of Science* 42 (4): 483-488.

Basso, Keith. 1996. *Wisdom Sits in Places: Landscape and Language Among the Western Apache.* Albuquerque: University of New Mexico Press.

Baumann, Duane. 1983. “Social Acceptance of Water Reuse.” *Applied Geography* 3 (1): 79-84.

Berk, Richard A., Daniel Schulman, Matthew McKeever, and Howard E. Freeman. 1993. “Measuring the Impact of Water Conservation Campaigns in California.” *Climatic Change* 24 (3): 233-248.

Bijker, Wiebe. 2012. “Do We Live in Water Cultures? A Methodological Commentary.” *Social Studies of Science* 42 (4): 624–627.

Blomquist, William. 1992. *Dividing the Waters: Governing Groundwater in Southern California.* Ithaca: ICS Press.

Bowker, Geoffrey C. and Susan Leigh Star. 2001. “Pure, Real and Rational Numbers: The American Imaginary of Countability.” *Social Studies of Science* 31 (3): 422–425.

Brigandi, Phil. 2001. *Borrego Beginnings: Early Days in the Borrego Valley, 1910-1960.* Borrego Springs, CA: Anza-Borrego Desert Natural History Association.

Bruvold, William H. 1972. “Public Opinion and Knowledge Concerning New Water Sources in California.” *Water Resources Research* 8(5): 1145-1150.

California State Water Resources Control Board. 2013. “Proposition 84: Stormwater Grant Program Round 2 Guidelines,” Rev. Ed. Sacramento, California.

Carroll, Patrick. 2012. “Water and Technoscientific State Formation in California.” *Social Studies of Science* 42 (4): 489–516.

Carson, Rachel. 1994 [1962]. *Silent Spring*. New York: Houghton Mifflin Company.

Cattelino, Jessica R. 2011. “Thoughts on the U.S. as a Settler Society: Plenary Remarks, 2010 SANA Conference.” *North American Dialogue* 14 (1): 1–6.

Checker, Melissa. 2005. *Polluted Promises Environmental Racism and the Search for Justice in a Southern Town*. New York: NYU Press.

Choy, Tim. 2011. *Ecologies of Comparison: An Ethnography of Endangerment in Hong Kong.* Durham: Duke University Press.

Cohen, Michael J., Jason I. Morrison, and Edward P. Glenn. 1999. *Haven or Hazard: The Ecology and Future of the Salton Sea*. Oakland: The Pacific Institute for Studies in Development, Environment, and Security.

Crate, S. and Nuttall, C., Eds. 2009. *Anthropology and Climate Change: From Encounters to Actions.* Walnut Creek: Left Coast Press.

Cronon, William. 1983. *Changes in the Land: Indians, Colonists, and the Ecology of New England.* New York: Hill and Wang.

Cronon, William. 1990. "Modes of Prophecy and Production: Placing Nature in History." *Journal of American History* 76 (4): 1122-1131.

Cronon, William. 1993. "Ecological Prophecies." In *Major Problems in Environmental History,* edited by Carolyn Merchant. Lexington: D.C. Heath and Company.

Dasmann, Raymond. 1994. "The Rangelands." *Green vs. Gold: Sources in California's Environmental History,* edited by Carolyn Merchant. Washington, D.C.: Island Press.

Davis, Margaret. 1994. *Rivers in the Desert: William Mulholland and the Inventing of Los Angeles.* New York: Perennial.

Dellapenna, Joseph. 2000. "The Importance of Getting Names Right: The Myth of Markets for Water." *William and Mary Environmental Law and Policy Review* (2000): 1-19.

Deverell, William and Greg Hise, eds. 2005. *Land of Sunshine: An Environmental History of Metropolitan Los Angeles*. Pittsburgh: University of Pittsburgh Press.

Deverell, William and David Igler, eds. 2008. *A Companion to California History.* West Sussex: Wiley Blackwell.

Ehrlich, Paul. 1968. *The Population Bomb.* New York: Ballantine Books.

Ehrlich, Anne and Paul Ehrlich. 2009. "The Population Bomb Revisited." E*lectronic Journal of Sustainable Development* 1 (3): 63-71.

Erie, Steven. 2006. *Beyond Chinatown: The Metropolitan Water District, Growth, and the Environment in Southern California.* Stanford: Stanford University Press.

Espeland, Wendy. 1998. *The Struggle for Water: Politics, Rationality, and Identity in the American Southwest.* Chicago: University of Chicago Press.

Faunt, Claudia C., Christina L. Stamos, Lorraine E. Flint, Michael T. White, Matthew K. Burgess, Michelle Sneed, Justin Brandt, Peter Martin, and Alissa L. Coes. 2015. "Hydrogeology, Hydrologic Effects of Development and Simulation of Groundwater Flow in the Borrego Valley, San Diego County, California." U.S. Geological Survey Scientific Investigations Report 2015-5150.

Ferry, David. 2015. "How the Government Put Tens of Thousands of People at Risk of a Deadly Disease." *Mother Jones,* January/February 2015.

Fortun, Kim. 2001. *Advocacy After Bhopal: Environmentalism, Disaster, New Global Orders*. Chicago: University of Chicago Press.

Fortun, Kim. 2004. "Environmental Information Systems as Appropriate Technology." *Design Issues* 20: 54-65.

Geertz Clifford. 1972. "The Wet and the Dry: Traditional Irrigation in Bali and Morocco." *Human Ecology* 1: 23–39.

Gibson-Graham, J.K. 2011. "A feminist project of belonging for the Anthropocene." *Gender, Place & Culture* 18 (1): 1-21.

Gilmore, Ruth Wilson. 1998/99. "Globalisation and US Prison Growth: From Military Keynesianism to Post-Keynesian Militarism." *Race & Class* 40 (2/3): 171-188.

Gilmore, Ruth. 2007. *Golden Gulag: Prisons, Surplus, Crisis, and Opposition in Globalizing California.* Berkeley: University of California Press.

Giordano, Mark. 2009. "Global Groundwater? Issues and Solutions." *Annual Review of Environment and Resources* 34 (1): 153–78.

Glacken, Clarence James. 1967. *Traces on the Rhodian Shore: Nature and Culture in Western Thought from Ancient Times to the End of the Eighteenth Century*. Berkeley: University of California Press.

Glasgow, Nina and E. Helen Berry, eds. 2013. *Rural Aging in 21st Century America.* Dordrecht: Springer Science+Business Media.

Gleick, Peter H. 2003. “Water Use.” *Annual Review of Environment and Resources* 28: 275-314.

Gleick, Peter H., Dana Haasz, Christine Henges-Jeck, Veena Srinivasan, Gary Wolff, Katherine Kao Cushing, and Amardip Mann. 2003. *Waste Not, Want Not: the Potential for Urban Water Conservation in California.* Oakland: The Pacific Institute for Studies in Development, Environment, and Security.

Glenn, Edward P., Michael J. Cohen, Jason I. Morrison, Carlos Valdés-Casillas, and Kevin Fitzsimmons. 1999. “Science and Policy Dilemmas in the Management of Agricultural Waste Waters: the Case of the Salton Sea, CA, USA.” *Environmental Science & Policy* 2 (4-5): 413-423.

Golley, Frank Benjamin. 1993. *A History of the Ecosystem Concept in Ecology: More Than the Sum of the Parts.* New Haven: Yale University Press.

Gottlieb, Robert and Margaret FitzSimmons. 1991. *Thirst for Growth: Water Agencies as Hidden Government in California.* Tucson: University of Arizona Press.

Griffin, Ronald C. 2012. “The Origins and Ideals of Water Resource Economics in the United States.” *Annual Review of Resource Economics* 4 (1): 353–77.

Gumprecht, Blake. 2005. “Who Killed the Los Angeles River?” In *Land of Sunshine: an Environmental History of Metropolitan Los Angeles*, edited by William Deverell and Greg Hise. Pittsburgh: University of Pittsburgh Press.

Hanak, Ellen, Jay Lund, Ariel Dinar, Brian Gray, Richard Howitt, Jeffrey Mount, Peter Moyle, and Barton “Buzz” Thompson. 2011. *Managing California’s Water: From Conflict to Reconciliation.* San Francisco: Public Policy Institute of California.

Haraway, Donna. 1988. “Situated Knowledges: The Science Question in Feminism as a Site of Discourse on the Privilege of Partial Perspective.” *Feminist Studies* 14 (3): 575-599.

Haraway, Donna. 2016. *Staying with the Trouble: Making Kin in the Chthulucene.* Durham: Duke University Press.

Hardin, Garrett. 1968. “The Tragedy of the Commons.” *Science* 162 (3859): 1243-1248.

Harding, S.T. 1960. *Water in California.* Palo Alto: N-P Publications.

Hastrup, Kirsten and Cecilie Rubow, eds. 2014. *Living with Environmental Change: Waterworlds*. New York: Routledge.

Hatai, K. 1983a. “A Preliminary Evaluation of Historical and Projected Water Demand for Borrego Valley.” State of California: Department of Water Resources: Southern District: Planning Branch. Technical Information Record Study Code No. 1335-12-C-1.

Hatai, K. 1983b. “Preliminary Evaluation of Annual Recharge to the Borrego Valley Groundwater Basin.” State of California: Department of Water Resources: Southern District: Planning Branch. Technical Information Record Study Code No. 1335-11-B-1.

Heizer, Robert F. 1998. “Native World Views.” In *Green vs. Gold: Sources in California’s Environmental History,* edited by Carolyn Merchant. Washington, D.C.: Island Press.

Helmreich, Stefan. 2009. *Alien Ocean: Anthropological Voyages in Microbial Seas*. Berkeley: University of California Press.

Helmreich, Stefan. 2011. “What Was Life? Answers From Three Limit Biologies.” *Critical Inquiry* 37 (4): 671–96.

Helmreich, Stefan. 2012. “Extraterrestrial Relativism.” *Anthropological Quarterly* 85 (4): 1125-1140.

Henley, A T. (1957). “The Evolution of Forms of Water Users Organizations in California.” *California Law Review* 45(5): 665-675.

Hogue, Lawrence. 2000. *All the Wild and Lonely Places: Journeys in a Desert Landscape.* Washington, D.C.: Island Press.

Howitt, Richard. 1994. “Empirical Analysis of Water Market Institutions: the 1991 California Water Market.” *Resource and Energy Economics* 16 (4): 357–71.

Hufford. 2016. “Engaging Cross-Disciplinary, Multi-Sectoral Study and Stewardship: The Seasonal Round as Boundary Object.” Presentation at Society for Applied Anthropology Annual Meeting. Vancouver, British Columbia.

Hughes, Sara and Stephanie Pincetl. 2014. “Evaluating Collaborative Institutions in Context: the Case of Regional Water Management in Southern California.” *Environment and Planning C: Government and Policy* 32 (1): 20–38.

Hundley, Norris Jr. 1992. *The Great Thirst: Californians and Water a History.* Berkeley: University of California Press.

Hundley, Norris Jr. 2001. *The Great Thirst: Californians and Water a History.* Revised Edition. Berkeley: University of California Press.

Hundley, Norris. 2009. *Water and the West: The Colorado River Compact and the Politics of Water in the American West.* Berkeley: University of California Press.

Hurtado, Albert. 1998. “Indians Encounter Spaniards”. *Green vs. Gold: Sources in California’s Environmental History.* Washington, DC: Island Press.

Ingold, T. 2000. *The Perception of the Environment: Essays on Livelihood, Dwelling, and Skill.* New York: Routledge.

Ingram, Helen and Cy R. Oggins. 1992. “The Public Trust Doctrine and Community Values in Water.” *Natural Resources Journal* 32: 515-537.

Israel, Morris, and Jay R. Lund. 1995. “Recent California Water Transfers: Implications for Water Management.” *Natural Resources Journal* 35: 1-32.

Jasanoff, S. 2006. *States of Knowledge: The Co-Production of Science and the Social Order.* New York: Routledge.

Jefferson, George and Lowell Lindsay. 2006. *Fossil Treasures of the Anza-Borrego Desert.* El Cajon: Sunbelt Publications.

Jonas, Andrew E. G. and Stephanie Pincetl. 2006. “Rescaling Regions in the State: the New Regionalism in California.” *Political Geography* 25 (5): 482–505.

Jørgensen, Dolly. 2013. “Environmentalists on Both Sides: Enactments in the California Rigs-to-Reefs Debate.” In *New Natures: Joining Environmental History with Science and Technology Studies,* edited by Dolly Jørgensen, Finne Arne Jørgensen and Sara B. Pritchard, 51–68. Pittsburgh: University of Pittsburgh Press.

Kahrl, William. 1982. *Water and Power: The Conflict Over Los Angeles’ Water Supply in the Owens Valley.* Berkeley: University of California Press.

Kallis, Giorgos, Michael Kiparsky, and Richard Norgaard. 2009. “Collaborative Governance and Adaptive Management: Lessons From California's CALFED Water Program.” *Environmental Science & Policy* 12 (6): 631–43.

Kelley, Robert. 1959. “Miners Encounter Farmers”. *Gold vs. Grain: The Hydraulic Mining Controversy in California’s Sacramento Valley: A Chapter in the Decline of the Concept of Laissez Faire.* Glendale: The Arthur H. Clarke Company.

Kenny, Douglas. 1999. “Historical and Sociopolitical Context of the Western Watersheds Movement.” *Journal of the American Water Resources Association* 35 (3): 493-503.

Kleinman, Arthur. 1988. *The Illness Narratives: Suffering, Healing, and the Human Condition.* New York: Basic Books.

Kuletz, Valerie. 1998. *The Tainted Desert: Environmental and Social Ruin in the American West.* New York: Routledge.

Lampland, Martha. 2010. "False numbers as formalizing practices." *Social Studies of Science* 40 (3): 377–404.

Latour, Bruno. 1987. *Science in Action: How to Follow Scientists and Engineers through Society* Cambridge: Harvard University Press.

Latour, Bruce. 2014. "Anthropology at the Time of the Anthropocene - A Personal View of What is to be Studied." Distinguished lecture American Association of Anthropologists. Washington, DC. December 2014.

Lears, Jackson. 1994. *Fables of Abundance: A Cultural History of Advertising in America.* New York: Basic Books.

Leopold, Aldo. 1966. *A Sand County Almanac with Essays on Conservation from Round River.* New York: Ballantine Books.

Lindsay, Diana. 2001. *Anza-Borrego A to Z: People, Places, and Things.* San Diego, CA: Sunbelt.

Little, Peter. 2013. *Toxic Town: IBM, Pollution, and Industrial Risks*. New York: NYU Press.

Madley, Benjamin. 2016. *An American Genocide: The United States and the California Indian Catastrophe, 1846-1873.* New Haven: Yale University Press.

Masco, Joseph. 2006. *The Nuclear Borderlands: The Manhattan Project in Post-Cold War New Mexico.* Princeton: Princeton University Press.

Maurer, Bill. 2006. "The Anthropology of Money." *Annual Review of Anthropology* 35: 15–36.

McCool, Daniel. 2012. *River Republic: The Rise and Fall of America's Rivers.* New York: Columbia University Press.

McNutt, Marcia. 2014. "The Drought You Can't See." *Science* 345 (6204): 1543.

Merchant, Carolyn. 1989. *Ecological Revolutions: Nature, Gender, & Science in New England.* Chapel Hill: University of North Carolina Press.

Merchant, Carolyn, ed. 1998. *Green Versus Gold: Sources in California's Environmental History.* Washington, D.C.: Island Press.

Merchant, Carolyn. 2007. *American Environmental History: An Introduction.* New York: Columbia University Press.

Mitman, Gregg. 1992. *The State of Nature: Ecology, Community, and American Social Thought, 1900-1950.* Chicago: University of Chicago Press.

Morton, Timothy. 2013. *Hyperobjects: Philosophy and Ecology after the End of the World.* Minneapolis: University of Minnesota Press.

Moyle, W. R. 1982. "Water resources of Borrego Valley and vicinity, California; Phase 2, definition of geologic and hydrologic characteristics of the basin." U.S. Geological Survey Open-File Report 82-855.

Mukerji, Chandra. 2009. *Impossible Engineering: Technology and Territoriality on the Canal du Midi.* Princeton, NJ: Princeton University Press.

Mulholland, Catherine. 2000. *William Mulholland and the Rise of Los Angeles.* Berkeley: University of California Press.

Munn, Nancy D. 1992. "The Cultural Anthropology of Time: a Critical Essay." *Annual Review of Anthropology* 21 (1): 93–123.

Murphy, Michelle. 2006. *Sick Building Syndrome and the Problem of Uncertainty: Environmental Politics, Technoscience, and Women Workers.* Durham: Duke University Press.

Nash, Linda. 2006. *Inescapable Ecologies: A History of Environment, Disease, and Knowledge*. Berkeley: University of California Press.

Nash, Roderick. 2001. *Wilderness and the American Mind.* 4th Edition. New Haven: Yale University Press.

Nash, Roderick. 1972. "American Environmental History: A New Teaching Frontier." *Pacific Historical Review.* 41 (3): 362-372.

National Drought Mitigation Center. (2014) U.S. Drought Monitor Classification Scheme. Available at http://droughtmonitor.unl.edu/AboutUs/ClassificationScheme.aspx (accessed 1 November 2014).

Nabham, Gary Paul. 2008. *Arab/American: Landscape, Culture, and Cuisine in Two Great Deserts.* Tucson: University of Arizona Press.

Ogden, Laura, Nik Heynen, Ulrich Oslender, Paige West, Karim-Aly Kassam, and Paul Robbins. 2013. “Global Assemblages, Resilience, and Earth Stewardship in the Anthropocene.” *Frontiers in Ecology and the Environment* 11 (7): 341–47.

Ogden, Laura. 2016. Comments at the 2016 American Anthropological Association Annual Meeting, Minneapolis.

Olson, Valerie. 2010. “The Ecobiopolitics of Space Biomedicine.” *Medical Anthropology* 29 (2): 170-193.

Opie, John. 1993. *Ogallala: Water for a Dry Land: A Historical Study in the Possibilities for American Sustainable Agriculture*. Lincoln: University of Nebraska Press.

Orlove, Ben. 2002. *Lines in the Water: Nature and Culture at Lake Titcaca.* Berkeley: University of California Press.

Orlove, Ben and Steven C. Canton. 2010. “Water sustainability: Anthropological approaches and prospects.” *Annual Review of Anthropology* 39 (1): 401–415.

Ostrum, Vincent. 1953. “Water & Politics: a Study of Water Policies and Administration in the Development of Los Angeles.” Vol. 35. Haynes Foundation.

Ottinger, Gwen. 2013. *Refining Expertise: How Responsible Engineers Subvert Environmental Justice Challenges.* New York: NYU Press.

Peterson, Nicole. 2015. “Unequal sustainabilities: The role of social inequalities in conservation and development projects.” *Economic Anthropology* 2 (2): 264-277.

Petryna, Adriana. 2003. *Life Exposed: Biological Citizens After Chernobyl*. Princeton: Princeton University Press.

Pint, Ellen M. 1999. “Household Responses to Increased Water Rates During the California Drought.” *Land Economics* 75 (2): 246-266.

Porter, Theodore. 1992. “Quantification and the Accounting Ideal in Science.” *Social Studies of Science* 22 (4): 633–652.

Povinelli, Elizabeth. 2011. *Economies of Abandonment: Social Belonging and Endurance in Late Liberalism.* Durham: Duke University Press.

Povinelli, Elizabeth. 2016. *Geontologies: A Requiem to Late Liberalism.* Durham: Duke University Press.

Pritchard, Sara. 2011. *Confluence: The Nature of Technology and the Remaking of the Rhone.* Cambridge: Harvard University Press.

Raffles, Hugh. 2002. *In Amazonia: A Natural History*. Princeton: Princeton University Press.

Rakestraw, Lawrence. 1972. "Conservation Historiography: an Assessment." *Pacific Historical Review* 41 (3): 271-288.

Reisner, Marc. 1993 [1986]. *Cadillac Desert: The American West and its Disappearing Water.* New York: Penguin Books.

Reisner, Marc. 1997. "Water Policy and Farmland Protection: a New Approach to Saving California's Best Agricultural Lands." Washington, D.C.: American Farmland Trust.

Shapin, Steven and Simon Schaffer. 1985. *Leviathan and the Air Pump: Hobbes, Boyle, and the Experimental Life.* Princeton: Princeton University Press.

Starr, Kevin. 1990. *Material Dreams: Southern California Through the 1920s.* New York: Oxford University Press.

Stengers, Isabelle. 2005. "Introductory Notes on an Ecology of Practices." *Cultural Studies Review* 11 (1): 183-196.

Strong, Douglas. 1988. *Dreamers and Defenders: American Conservationists*. Lincoln: University of Nebraska Press.

Tuan, Yi-Fu. 1990. *Topophilia: A Study of Environmental Perceptions, Attitudes, and Values*. New York: Columbia University Press.

Tuan, Yi-Fu. 2001. "The Desert and I: A Study in Affinity." *Reimagining Place* XL (1).

Tsing, Anna Lowenhaupt. 2005. *Friction: An Ethnography of Global Connection.* Princeton: Princeton University Press.

Tsing, Anna Lowenhaupt. 2015. *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins.* Princeton: Princeton University Press.

U.S. Census Bureau. 2010. Profile of General Population and Housing Characteristics: 2010 Demographic Profile Data, Table DP-1. Available at http://factfinder2.census.gov. Generated by Emily Brooks, using American FactFinder (accessed 1 June 2015).

U.S. Census Bureau. 2013. Selected Economic Characteristics: 2009-2013 American Community Survey 5-Year Estimates, Table DP03. Available at http://factfinder2.census.gov. Generated by Emily Brooks, using American FactFinder (accessed 1 June 2015).

U.S. Census Bureau. 2015. ACS Demographic and Housing Estimates: 2011-2015 American Community Survey 5-Year Estimates, Table DP05. Available at http://factfinder2.census.gov. Generated by Emily Brooks, using American FactFinder (accessed 23 May 2017).

Valentine, David, Valerie A. Olson, and Debbora Battaglia. 2012. "Extreme: Limits and Horizons in the Once and Future Cosmos." *Anthropological Quarterly* 85 (4): 1007-1026.

Walker, Dan. 2004. *Thirst for Independence: The San Diego Water Story*. El Cajon: Sunbelt Publications.

Waller, Tom. 1994. "Expertise, Elites, and Resource Management Reform: Resisting Agricultural Water Conservation in California's Imperial Valley." *Journal of Political Ecology* 1: 13-42.

Walton, John. 1992. *Western Times and Water Wars: State, Culture, and Rebellion in California*. Berkeley: University of California Press.

Walton, John. 1993. *Western Times and Water Wars: State, Culture, and Rebellion in California*. Berkeley: University of California Press.

Worster, Donald. 1982. "Hydraulic Society in California: An Ecological Interpretation." *Agricultural History* 56 (3): 503-515.

Worster, Donald. 1984. "History as Natural History: An Essay on Theory and Method." *Pacific Historical Review* 53 (1): 1-19.

Worster, Donald. 1990. "Transformations of the Earth: Toward an Agroecological Perspective in History." *Journal of American History* 76(4).

Worster, Donald. 1993. "Ecological History". *Major Problems in Environmental History.* Edited by Carolyn Merchant. Lexington: D.C. Heath and Company.

Worster, Donald. 1994. *Nature's Economy: A History of Ecological Ideas*. New York: Cambridge University Press.