Ethnobiology

Meredith Welch-Devine
Anne Sourdril
Brian J. Burke *Editors*

Changing Climate, Changing Worlds

Local Knowledge and the Challenges of Social and Ecological Change

Springer

Ethnobiology

Ethnobiology is the study of the dynamic relationship between plants, animals, people, and the environment. Academic and applied interests include ethnobotany, ethnozoology, linguistics, paleoethnobotany, zooarchaeology, ethnoecology, and many others. The field lies at a dynamic intersection between the social and biological sciences. The major contribution from the biological sciences has come from economic botany, which has a rich historical and scientific tradition. Indeed, the objectives of the colonial enterprise were as much about the quest for "green gold" –herbal medicines, spices, novel cultivars, and others—as it was for precious metals and sources of labor. The view that ethnobiology concerns mostly the discovery of new and useful biota extended into the 20th century. The social sciences have contributed to the field in both descriptive studies but also within quantitative approaches in cognitive anthropology that have led to general principles within ethnobiological classification. Ethnobiological research in recent years has focused increasingly on problem solving and hypothesis testing by means of qualitative and especially quantitative methods. It seeks to understand how culturally relevant biotas are cognitively categorized, ranked, named, and assigned meaning. It investigates the complex strategies employed by traditional societies to manage plant and animal taxa, communities, and landscapes. It explores the degree to which local ecological knowledge promotes or undermines resource conservation, and contributes to the solution of global challenges, such as community health, nutrition, and cultural heritage. It investigates the economic value and environmental sustainability to local communities of non-timber forest products, as well as the strategies through which individual ecological knowledge and practices encourage resilience to change—modernization, climate change, and many others. Most importantly, contemporary ethnobiological research is grounded in respect for all cultures, embracing the principles of prior informed consent, benefit sharing, and general mindfulness.

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Foreword

This book could not be better timed. It hits the printing press as the second decade of this new millennium comes to a close, after a series of dreadful events that dispel any doubt that our planet is in dire peril. Climate change poses a formidable threat to both the Earth and the people who inhabit it, as exemplified by the grim lineup of hurricanes, floods, droughts, and wildfires that we have experienced this year alone. Evidence is piling up in science circles that glaciers are disappearing, oceans are warming and acidifying, and crop yields and food supplies are being threatened at unprecedented rates. The Amazon forest is devastated by fire and, even worse, destroyed for large-scale agriculture, industrial logging, and mining in ways that dangerously approach a tipping point.

Yet, this book is unexpectedly affirming and forward-looking. It encourages us to look beyond the parade of natural disasters and the natural impulse to despair, neither of which are as "natural" as they seem. The authors make this clear by reframing our understanding of global environmental change in ways that place humanity, and the cultures, societies, histories, and narratives it creates, squarely at the center. While this perspective leaves no escape from the recognition of our responsibilities, it equally and positively points to agency and options that remain available to us, as anthropologists, scientists, policy-makers, activists, and citizens, to transform the way we relate to the natural world and our place in it. This framing is supported by a number of critical and timely insights that stem from this volume: two in particular stand out as uniquely generative.

First, the authors made a convincing case for the indivisibility of humans and natural systems. People do not simply observe, understand, manage, or measure environmental phenomena as if they were external to their being. Rather, we exist in and engage with the environment in ways that are mediated by our senses, feelings, thoughts, values, and stories. That is true for momentous as well as mundane manifestations of global change which are felt on the skin, in the soul, and within the mind. Across the wide and rich plurality of such experiences, this reality is shared across humanity, and, as such, it can offer fertile ground for coalition building and resistance movements. It can propel and unite efforts to confront "long histories of inequality" and "uneven geographies of destruction" (as stated in the editors'

introduction) and to sustain collective action at multiple scales. The recent school strikes and street protests by young people across the globe to shake world leaders out of their inertia on climate change are an inspirational example. Less widely covered in the popular media but equally energizing is the emergence of worldwide alliances of indigenous people for environmental and climate justice. For example, a Local Communities and Indigenous Peoples Platform was recently convened within the UN Framework Convention Climate Change Conference to promote legitimate representation of indigenous groups in global climate change negotiations. Of course, these actions and voices confront formidable political hurdles and economic interests that stand in the way, but they do renew our faith in the actual possibility of social transformation.

This brings us to a second important insight that infuses most chapters and is articulated in the conclusion to the book. Changing the way we engage with nature and with other human and nonhuman beings in nature requires more than improving policies and practices (though doing so would surely be a welcome head start). It calls for a more radical shift in how we gain and use environmental knowledge, turning away from colonizing epistemologies toward politically engaged, diversity-embracing ways of knowing. Anthropology's genesis in colonial times and places, and its historical record of manufacturing knowledge that reifies research subjects, erases difference, and upholds the status quo calls for intentional reflexivity by those of us who have been trained in this discipline. Auspiciously, as outlined in the concluding chapter, growing numbers of anthropologists are breaking out of the mold and leading the way in co-producing streams of research which document, contextualize, include, and mobilize other ways of knowing our changing climates. Even then, in addition to entrenched interests and ideologies, engaged anthropologists and academics face powerful challenges that stem from the established systems and criteria that govern performance evaluation and career advancement in US universities. These structures – which continue to promote disenfranchising epistemologies – must be decolonized at last.

Published a decade after the landmark volume *Anthropology and Climate Change: From Actions to Transformations* (Crate and Nuttall eds. 2009) – which foregrounded the vast potential offered by the discipline to enrich analyses, policies, and practices centered on global change – the current collection strides even further. It challenges us to critically examine the knowledge production processes and contexts we engage in. It equally urges us to balance the pursuit of academic excellence and theoretical rigor with a commitment to public scholarships that nurtures a vibrant and visionary environmental citizenship.

Atlanta, Geogia, USA Carla Roncoli

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About the Editors

Meredith Welch-Devine is Director of Interdisciplinary Graduate Programs at the UGA Graduate School and an Adjunct Faculty Member in the Department of Anthropology. Her primary research interests include climate change perceptions and adaptation, impacts of sea level rise and extreme weather events on coastal populations, collective management of common-pool resources, and policy and practice related to conservation and sustainability. Her dissertation research – set in the Basque region of France – centered on the implementation of the European Union's Habitats Directive in an agricultural area with a strong common property regime. This directive created a pan-European network of conservation sites, called Natura 2000, and was the subject of intense resistance by the local population. Since that time, she has continued to collaborate with Basque farmers on research related to sustainable agriculture. Closer to home, she has been associated with the Coweeta Long-Term Ecological Research program since 2003, where she has sought to understand how people observe and make sense of changes in their environment, including climate change. Most recently, she has worked on the Georgia coast to understand how people view their adaptation options, including migration away from the coast, in the face of increasing storm severity. This work also provides a starting point for a collaboration with faculty in history and in design that will use augmented and virtual realities to explore environmental pasts, presents, and futures with research participants.

Anne Sourdril is a Social Anthropologist, Research Fellow at the CNRS, and Member of the Laboratoire Dynamiques Sociales et Recomposition des Espaces (UMR 7533 Ladyss). Her research focuses on the dynamics of socio-ecological systems in the context of long-term environmental change. She is working on the processes of spatial greening, the multiplication of measures to protect and conserve nature or biodiversity, and the reconfiguration of landscapes. She is interested in the dynamics of everyday biodiversity and its associated knowledge and representations. Her latest work focuses on the sounds of nature and soundscapes seen as indicators of environmental change and notably climate changes. She addresses these issues in interdisciplinary and comparative research programs. Her research sites are located in southwestern France, western North Carolina, and more recently southern Arizona.

Brian J. Burke is an Associate Professor in the Goodnight Family Sustainable Development Department at Appalachian State University. His research examines popular understandings of environmental and economic issues, as well as grassroots mobilization to address these issues. Since 2012, he has focused largely on local environmental knowledge and strategies for scientist/nonscientist collaboration in Southern Appalachia, including via work with the Coweeta Long-Term Ecological Research Program, the Coweeta Listening Project, the PIAF Project, and collaborative research with Meredith Welch-Devine. His research has also included a variety of short- and long-term ethnographic engagements examining sustainable development, environmental health activism, ecovillages, and noncapitalist/solidarity economies (alternative currencies, barter systems, fair trade, and cooperatives) in Latin America.

Chapter 1
Understanding Microexperiences of Climate Change: How Climate Ethnography Informs Collaboration, Adaptation, and Effective Responses

Brian J. Burke, Meredith Welch-Devine, and Anne Sourdril

Abstract Projections of climate change, biodiversity loss, and associated socioeconomic impacts are increasingly dire. In this volume, we turn our attention from the spectacular scenes of climate disruption to the slow and subtle, the small but consequential shifts in the species and landscapes that we humans interact with on a constant basis. This introductory chapter offers an analytical framework for the chapters that follow. Synthesizing lessons from environmental anthropology, we argue that *microexperiences of change* offer a critical but neglected lens for understanding the Anthropocene as a new geological, cultural, and political era. Focusing on microexperiences allows us to examine how individuals and communities are experiencing climate change in intimately meaningful ways, how they are constructing knowledge based on these experiences, and how that knowledge shapes their responses. This in turn provides unique insights into the diverse ways that people are embedded in their environments; the dynamics of differentiation, inequality, and violence that result from that; and how these affect knowledge, denialism, and climate responses. Perhaps most importantly, examining climate change at the resolution of microexperiences has the advantage of showing us change where many people—perhaps especially those whose livelihoods, social relations, and cultures are most intimately linked to the environment—see it, feel it, and make sense of it. Careful analysis and appreciation of these microexperiences and the resulting knowledge systems may therefore broaden the foundation for shared understanding and collaborative action to address climate change in an inclusive and effective manner.

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Global climate change activism took on new urgency in October 2018, when the Intergovernmental Panel on Climate Change (IPCC) released a special report warning that the Earth will suffer severe consequences if carbon emissions are not cut more deeply and on a much faster timeline than previously thought necessary. Commissioned during the 2016 Paris Climate Conference at the urging of small island states and other highly vulnerable countries, the report detailed the impacts that would result from only 1.5 °C of warming above preindustrial levels rather than the 2 °C that has been the focus of international policy since Kyoto. The results were sobering. Even at this lower threshold, we will face reduced food security, increased exposure to extreme weather events, and dramatic loss of biodiversity as soon as 2040. Maize, rice, and wheat yields will decline globally, storms will continue to become more violent and damaging, and 70–90% of tropical coral reefs are expected to die (Hoegh-Guldberg et al. 2018).

The links between climate, biodiversity, and human well-being are clear. In May 2019, the global assessment for biodiversity and ecosystem services[1] warned that more than one million species are at risk of extinction due to five key drivers—land and sea use change, direct exploitation of species, climate change, pollution, and invasion of non-native species—and that climate change is increasingly exacerbating the impact of these other drivers (IPBES 2019: 3). The IPBES report declares current biodiversity conservation measures inadequate and illustrates that extirpation and extinction have highly significant social, economic, political, and moral consequences. Among other impacts, the continued degradation of nature "will undermine progress toward 80 percent (35 out of 44) of the [Sustainable Development Goals] related to poverty, hunger, heath, water, cities, climate, oceans and land" (IPBES 2019: 6). The global assessment points to dramatic impacts that have already happened under only 1 °C (+/− 0.2) of warming, including heat waves, storms, and droughts, as well as more subtle shifts such as earlier springs and changes in phenology and primary production. Climate change is likely to interact with other drivers in unexpected ways, potentially exacerbating species loss and leading to irreparable damage to the Earth and those who dwell here.

To avert catastrophe, the authors of both reports call for nothing short of transforming the world's economy. According to the IPCC, "pathways limiting global warming to 1.5 °C… require rapid and far-reaching transitions in energy, land, urban and infrastructure…, and industrial systems" (IPCC 2018: 21) so that greenhouse gas emissions can be reduced by 45% from 2010 levels by 2030 and to net zero by around

[1] As of this writing, the global assessment was available in draft form, with the final chapters to be released in late 2019. We draw here on an advance unedited copy of the Summary for Policymakers.

2050. IPBES additionally calls for a significant democratization of environmental governance, the establishment of socio-ecological well-being as a central criterion for resource use planning, and the widespread implementation of policies to eliminate negative environmental externalities. These tasks may seem daunting, but it is increasingly clear that we must dedicate ourselves fully to "transformative change" to protect human and ecological well-being through nature conservation, sustainable resource use, climate adaptation, and greenhouse gas mitigation. Fortunately, these transformative visions are not shots in the dark: they have been thoroughly evaluated in terms of both their ability to improve well-being and their cost-effectiveness (see, e.g., Brown et al. 2018, Hawken 2017, Jacobson et al. 2018, and UNEP 2012–2018).

In the United States, the IPCC report was released during one of the worst years on record for "natural" disasters. The year began with mudslides killing 21 people in Montecito, California; these slides were triggered by rainfall that exceeded half an inch in only 5 minutes. Later that spring, Maryland experienced flash flooding when more than 8 inches of rain fell in a few hours in Howard County. In the fall, California was hit by the deadliest wildfire in its history—the Camp Fire—and the East Coast saw Hurricanes Florence and Michael, which caused record-breaking flooding and damage. The United States was no exception. In the same time period, South Africa faced a critical drought that left Cape Town's four million residents just months away from running out of water. Early in 2019, Tropical Cyclone Idai pummeled Mozambique, Zimbabwe, Madagascar, and Malawi, killing more than 1000 people and causing more than $2 billion in damages, only to be followed by Tropical Cyclone Kenneth just 5 weeks later. Perhaps influenced by watching those epic storms unfold, in early May of 2019, India managed the gargantuan task of evacuating more than 1 million people from the path of Cyclone Fani. In September, northern islands of the Bahamas were devastated by Hurricane Dorian. In each of these disasters, some escaped the worst harm, while others had their lives completely and permanently upended. The uneven geography of destruction underscores yet again the role that political-economic factors play in delivering ruin to some while allowing others simply a "close call" (Taylor 2014). Disasters do not "fall from the sky" (Ribot 2010; Smith 2006); they arise from long histories of inequality that have created institutional and social structures that ensure that some among us will always have a harder time preparing for, weathering, and recovering from extreme events.

The horrific scale of today's climate disasters commands our attention, prompts philanthropy and policy discussions, and has even given rise to a new genre of literature and film: climate fiction, or "Cli-Fi." But in many ways, the focus on the dramatic obscures other, more subtle, ways that people are experiencing climate change in their everyday lives. Though these effects may not grab headlines, unpredictable rains, less reliable harvests, and disappearing animals can be devastating to those whose livelihoods depend most directly on the environment. In southern Europe, for example, unusually heavy rains in 2018 triggered erosion and mudslides that ruined newly sown fields, while strong storms destroyed fruit and vegetable harvests. In each case, community solidarity was key to recovery, highlighting the crucial role of social institutions and cultural practice in resilience, adaptation, and transformation.

It is also evident that watching the loss and permanent change of our landscapes and homes causes real grief (Cunsolo and Ellis 2018). The salamanders we used to catch as kids, the cornflowers, poppies, or orchids that sprinkled hillsides with color, or the songbird we first learned to imitate, when they disappear, it hurts. Beyond causing distress, the loss of species and associated memories also erodes the local representations of nature that contribute to cultural diversity. Local biodiversity losses coupled with an increase in invasive species can disturb processes of building, maintaining, and transmitting the high specialized vernacular knowledges essential to understanding and managing environments in a context of global change (Cruikshank 2005; Nadasdy 2003).

With this volume, we turn our attention from the spectacular scenes of climate disruption to the slow and subtle. We shift focus from the extreme events, catastrophes, and chaos that dominate public representations of climate change— even in the usually sober realms of international policy and scientific synthesis—to small but consequential shifts in the species and landscapes that we humans interact with on a constant basis. Here, we foreground the *microexperiences* of change, suffering, and risk, illustrating how individuals and communities are experiencing climate change in intimately meaningful ways, how they are constructing knowledge based on these experiences, and how that knowledge shapes their responses.

These microexperiences of climate change are, we argue, a critical but neglected component of our understanding of the Anthropocene as a new geological, cultural, and political era. Of course, macroexperiences are important, too. Without the careful construction of global models, we would not understand the multiple drivers, trajectories, and effects of climate change, and many people have come to understand and respond to climate change through the globally scaled imagery and narratives that emanate from scientific synthesis, international policy, and activism. For many others, however, stories of global dynamics and distant impacts seem like mere abstractions. Examining climate change at the resolution of microexperiences has the advantage of showing us change where many people—perhaps especially those whose livelihoods, social relations, and cultures are most intimately linked to the environment—see it, feel it, and make sense of it. Careful analysis and appreciation of these microexperiences and the resulting knowledge systems may therefore broaden the foundation for shared understanding and collaborative action to address climate change in an inclusive manner.

1.1 Key Insights for Climate Ethnography

This volume's focus on microexperiences contributes to what Susan Crate calls "climate ethnography." Crate argues that ethnography offers a particularly valuable complement to other ways of knowing climate change because ethnography maintains an analytical focus on both "the specifics and multilayered complexities of local human experience" and "the generalities and abstractions of… the global" (2011: 176). Because ethnography "is a comprehensive method that capitalizes on

anthropologists' skill in 'being there,' [it] has the methodological power to bridge local understandings beyond the local" so that a "multitude of stakeholders… on a multitude of scales" can develop effective, coordinated policies and responses (177). However, she also underscores an important point: not all ethnography related to climate change counts equally as climate ethnography. True climate ethnography, she argues, should be critical, collaborative, and multi-sited. We therefore use this introduction to frame our diverse case studies of microexperiences of climate change within the scope of critical theory and to begin drawing lessons across our international cases. We believe that a deeper understanding of potential adaptations to climate change will arise from thinking across multiple local ethnographies, and we hope readers will contribute to this cross-pollination.

While contributors to this volume were trained in a range of disciplines, our approach is primarily anthropological. Four key themes from the field of environmental anthropology are present—sometimes explicitly but often implicitly—in the chapters included here. The first theme is a central tenet of environmental anthropology: that the environment is not just something "out there" that we draw on for resources, or that we pollute and disturb, or that threatens us from time to time. Rather, the chapters within this book underline that we are part of the environment, and we must understand it as the matrix of our everyday existence in a holistic and integrative way. Indeed, even this language of "we" and "it" does not do justice to the indivisibility of nature-culture and the diverse ways that people understand this connection (Descola 2013). Three broad areas of research have flowed from this. The first (ethnoecology, cultural ecology, ecological knowledge) examines people's use of the environment, cultural adaptations to different environments, and the knowledge that people develop as they devise livelihood and social systems through unique assemblages of human and nonhuman elements (Balée 2002, 2013; Berkes 1999; Menzies 2006; Nadasdy 1999; Rappaport 1979; Steward 1972). The second (political ecology) examines how power and exploitation are enacted through the environment and reflected in the environment, for example, via rules of access, the distribution of environmental benefits and harms, control over environmental governance, or the relegation of certain groups to "sacrifice zones" (Wolf 1972; Bryant and Bailey 1997; Greenberg and Park 1994; Robbins 2012; Rocheleau et al. 1996). The third (anthropology of nature) explores diverse ontologies, arguing that every cultural group classifies and understands the world in fundamentally different ways and that we therefore live in actually different worlds, the "truth" of which we cannot judge because there is no unfiltered perspective (de la Cadena 2015; Descola 1994, 2013; Escobar 2006; Kohn 2013; Latour 2004; Viveiros de Castro 1998). All three of these areas of study also speak to the construction of identities, values, and visions for the world in and through the socio-environment.

The second theme we want to underscore is that each of the areas of study mentioned above includes a focus on differentiation and inequality. Together, they consider the different and unequal ways in which people use the environment, develop understandings of it, are impacted by changes in it, and have influence over it. In the case of the ontological turn in anthropology, they also interrogate the very different environments that people experience. This focus on difference is an important com-

plement to the generalizations created by global perspectives on climate change—understanding the full range of human responses to climate change and the implications of those responses requires that scholars think beyond generalizations and population trends to also discern meaningful variation (Adger et al. 2013; Barnes et al. 2013; Roncoli et al. 2009). Perhaps most importantly, understanding this diversity allows us to examine relations of complementarity (of groups of people, knowledge systems, and responses) and competition, coercion, and oppression (due to the prioritization of certain knowledges over others, the normalization of certain cultural values or ontologies over others, etc.) (Berkes et al. 2000; Goulden et al. 2009; Lazrus 2016; Marino 2018; Nadasdy 1999; Nelson and Finan 2009; Rice et al. 2015). Thus, we would argue, a micro-experiential perspective is necessary (though not sufficient) for thinking about and planning for a just response to climate change.

Third, one consequence of diversity and inequality is violence, and we would especially like to highlight the multiplicative violences that arise as climate change intersects with other environmental, economic, and sociopolitical burdens (Bunce et al. 2009; Djoudi et al. 2016; O'Brien et al. 2004; Watts 1983). A changing climate brings with it both the "slow violence" (Nixon 2011) of rising seas and increasing weather variability and abrupt catastrophes like monster wildfires and powerful hurricanes (Rahmstorf and Coumou 2011). The unnaturalness of both types of disaster is one of the reasons that ethnographic approaches are valuable for discerning how and why violence manifests in particular ways for particular populations (Oliver-Smith 2013). At face value, slow violence may seem analogous to microexperiences, while rapid disasters parallel macrophenomena. A strength of ethnography, however, is revealing how processes interact across different temporal and spatial scales (Crate 2011). Marino's (2015) analysis of climate change, vulnerability, and environmental displacement in Alaska offers a strong example in this regard. She illustrates how slow changes like global warming and erosion, punctuated impacts like floods, cyclical dynamics like seasonal subsistence calendars, and historical dynamics like settler colonialism and the construction of the "fourth world" in the Americas collectively shape one another and shape the local and global experiences of climate refugees. Anthropological analysis also offers the critical interrogation of "solutions," including attention to the possible violences of our climate change responses (Marino and Ribot 2012; Nightingale et al. 2019).

Fourth, environmental anthropology helps us understand the social organization of knowledge and denial. Ethnoecologists have long documented the division of labor in the environment and the resulting distribution of environmental knowledge. A number of scholars using ethnographic approaches have also offered extraordinarily insightful analyses of how denialism, skepticism, and confusion are constructed and maintained in the realms of climate change (Norgaard 2011), environmental injustice (Auyero and Swistun 2009), and other environmental public health problems (Kleinman 1998; Kleinman and Suryanarayanan 2012). Two key insights emerge from this literature. First, if environmental knowledge is distributed across society, then successfully addressing problems of human survival and adaptation often requires effective collaboration across broad networks. Political

ecology teaches us that such collaboration is no small feat given that power is often exercised via the monopolization of knowledge about the environment and control over the environment (Burke and Heynen 2014; Forsyth 2003; Goldman et al. 2010; Nadasdy 1999). Detailing the co-organization of knowledge and power may aid in developing innovative strategies for establishing solidarity across radical difference. Second, this literature reveals that knowledge does not simply exist and spread, and knowledge does not lead in any straightforward way to action. Rather, knowledge, non-knowledge, and action are all products of particular forms of social organization and are shaped by cultural and communicative norms (see especially Norgaard). As we attempt to understand and confront what is likely the greatest challenge humanity has ever faced, it is therefore important to interrogate not only what is (is climate change happening, who will be affected, how vulnerable are they, etc.) but also how we come to know and think about what is (i.e., what is the social and cultural context that shapes our understanding and response). This is perhaps one of the most valuable contributions of these chapters, and it is one of the places where attention to the diverse microexperiences of climate change is most critical.

Collectively, these four themes in environmental anthropology remind us of a critically important lesson laid out so clearly by Marcus Taylor (2014): climate change adaptation is not a "self-evident analytical framework and normative goal" (xi). Adaptation, like climate change itself, is perceived and theorized differently by different people, provoking different types of responses with different levels of effectiveness and different distributions of socio-ecological benefits and harms. Adger et al. (2011) and McDowell and Hess (2012) point out that adaptation to one stressor can reduce capacity to respond to other stressors, and Atteridge and Remling (2018) add that adaptation, rather than reducing vulnerability, can simply serve to redistribute it to others. Taylor goes farther, though, arguing that a focus on vulnerability and adaptation can itself obscure questions of power and sustainability and impede critical thinking about our changing climate. We would argue that an ethnographic lens and a focus on microexperiences can help speak to those concerns by highlighting particular people's knowledges and worldviews and demonstrating how specific responses have concrete impacts on social organization, equality, suffering, and violence. Importantly, such an approach tells a subtle and nuanced story, highlighting triumphs, failures, and the much more common "mixed results" in between.

1.2 This Volume

The chapters in this volume take us to diverse settings in South America, Africa, Europe, Asia, and North America—from cities to farms, alpine meadows to lowland jungles. In each, we see the commonalities of human experience, the connections we make with our environments, the ability of local societies to perceive and face change, and the emotions that emerge from change. In them we also see difference. What matters to whom, when, and why is inflected with history and shaped by cul-

ture, place, and circumstance. We see disconnection, misunderstanding, and fear, along with deep ties to place, hope, and collective action. Perhaps most importantly, these chapters show that our diverse histories and experiences give rise to different ways of knowing and being in our environment and highlight the value that comes from bringing those different perspectives into conversation about our shared future.

This book opens with a contribution from Puerto Rico, where Seara, Pollnac, and Jakubowski examine the impact of environmental degradation and climate change on a small-scale fishery. Focusing on perceptions as motivators of behavior, the authors investigate how fishers perceive their changing environment and seek to understand what influences those perceptions. They find that fishers have diverse ways of experiencing their environment and that education, age, and time in the profession all influence perceptions of degradation. Fishers have responded to change in many ways, and the authors underscore the many factors that influence willingness and ability to adapt and what responses fishers choose. Some of the changes fishers have made (e.g., fishing farther from shore and deeper) have serious potential consequences for health and safety. Dervieux and Belgherbi's study focuses on residents of communal lands near Hwange National Park in Zimbabwe. They find that residents have identified a very broad range of changes in their environment—in weather, species, and landscape. Dervieux and Belgherbi link these observations and interpretations to a violent history of oppression, dispossession, and relocation. Importantly, the discourses that villagers use to discuss environmental changes are also "an expression of their own deprivation." Having been "dispossessed of their rights over the land and the natural resources of their environment for more than a century," the discourses of science and law are of little use to them. Cultural explanations focused on the anger of ancestors help fill the gap in expressing moral outrage, fear, and concern. Together, these two chapters underscore the point that violence arises not only from the effects of a changing climate but also from our responses to it.

The third chapter takes us to the Eastern Himalaya. Salick, Staver, and Hart interrogate the interrelationship between climate change, vegetation change, and human adaptation. This chapter in particular shows how tightly linked human and natural systems are, laying out the interplay and feedback loops between changes in plant communities and human responses to that change. Sourdril and colleagues also focus on plants, this time in southern France, where their investigation of "weeds" and how to address them opens questions of social conflict, territorial reform, and rural migration. This is followed by a contribution from Raimond and colleagues, in which they address experimentation by farmers in the Sudano-Sahelian area of Cameroon. The authors show that some changes characterized by scientists as climate impacts—such as variations in temperature, rains, or wildlife populations—are explained by local communities as resulting from deforestation, changing agricultural practices, or population increases. These three chapters illustrate how climate change is intertwined with demographic shifts, changes in traditional practices, and other forms of environmental and social change. Much as humans cannot be analytically "isolated" from their environment, climate cannot be completely disentangled from other drivers of change. Indeed, one benefit of examining microexperiences of climate change is that people often interpret these experi-

ences in an already-integrated manner. Popular knowledge may thus provide important clues for scientists pursuing socio-ecological synthesis or research on coupled natural-human systems.

In the sixth chapter, Katz, Lammel, and Bonnet write of seasonal water levels and flooding in the Brazilian Amazon, comparing the perceptions of local residents with those of natural scientists. Their work illustrates both the conflict and complementarity of these different bodies of knowledge, highlighting the role of scale and occupation in determining knowledge and perception. The two following chapters, from Roque de Pinho and Reyes-Garcia and colleagues, point to ways to bring different types of knowledge together. Roque de Pinho uses PhotoVoice with Maasai pastoralists to understand climatic variability, extreme drought, and animal response, and Reyes-Garcia and colleagues detail a citizen science initiative to gather and share information related to climate change impacts. Drawing on a similar project dedicated to traditional knowledge in Spain, the authors are developing a global platform to collect indigenous and local knowledge on indicators of climate change, complementing instrumental weather and climate observations. These three cases thus highlight multiple ways to integrate the knowledge of scientists and nonscientists, showing the clear benefits that can be derived from these collaborations but also detailing the challenges to achieving authentic participation. As Pennesi argues in the conclusion, these are valuable contributions to a long-term project to decolonize and democratize knowledge and environmental governance.

The final two chapters also address collaboration across social difference, focusing not only on the complementarity of different knowledge systems but also prospects for more inclusive and democratic decision-making about how to craft the socio-ecological futures we want. In the first, Burke and colleagues write of the potential for finding common ground in climate discussions in southern Appalachia (southeastern United States) by focusing on local observations of change rather than far-off and abstract images. By coming together around what different people have seen and experienced first-hand, there is potential to leave behind political polarization and group stereotypes, instead viewing differences in knowledge and experience as strengths to be drawn upon. In the second, we return to east Africa, where Galvin and colleagues participated in collaborative workshops with other scientists and with pastoralists focused on responding to challenges and improving well-being. The workshops were pastoralist-led and paid careful attention to differences in knowledge generated by social position or occupation. These workshops illustrate how diverse participants can collectively identify pathways toward a healthier and more secure future.

In her conclusion, Karen Pennesi considers how these chapters contribute to four goals of anthropological research on climate change: documentation, connection, collaboration, and social transformation. She summarizes the numerous impacts and adaptations that are documented throughout this book and notes, importantly, that people's "observations are made with both bodies and minds, and the effects are felt in profound emotional and psychological—not just physical—ways." Appreciating the multifaceted experience of climate change is one of the central goals of climate ethnography. Pennesi teases out two ways that these chapters contribute to building fruitful connections—by illustrating how scientists and nonscien-

tists can connect in mutually enriching collaboration and by illustrating how we all may think more carefully about the connections between climate and other social and political-economic changes. Finally, she discusses how the chapters here contribute to activism for social transformation. "This book," she writes, "helps us see the importance of developing adaptive strategies for climate change that take into account sociocultural factors influencing relationships between people and their environment, as well as relationships among people that are mediated by the environment." But we must do significantly more if we are to achieve the transformation necessary to avert the multiple environmental and human crises that we currently face. Pennesi therefore concludes by suggesting how these authors might go further and by offering a vision for a radically democratized and anti-colonial/de-colonial system of environmental knowledge and governance.

Like Pennesi, we believe that effective and just responses to the intersecting crises and violences of the present—which include the local and the global, the dramatic and the mundane, and the ecological and the sociopolitical—demand decolonization and democratization. Indeed, this is often neglected in the recommendations of international science and policy communities. In this book, we contribute to this democratization by highlighting people's diverse experiences of climate change, the multiple knowledge systems they employ in responding to local and global changes, and strategies for honoring this plurality in our collective responses. We hope that these chapters will be useful to those who aim to carry this project further, toward a more complete democratization and decolonization of knowledge, politics, and economics, and toward the construction of more just and sustainable societies.

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Chapter 2
Fishers' Perceptions of Environmental and Climate Change in Puerto Rico: Implications for Adaptation and Sustainability

Tarsila Seara, Richard Pollnac, and Karin Jakubowski

Abstract Marine fisheries in the Caribbean are vulnerable to a wide range of environmental and climatic change impacts. Direct and indirect effects of these impacts on fish species affect the ability of fishers to harvest them resulting in reductions in revenue and food security. Understanding factors impacting and transforming fisheries from the viewpoint of the fishers is crucial for developing adequate strategies to maximize coastal communities' resilience and adaptation to change, particularly under future climate change scenarios. This study uses qualitative and quantitative data collected from 212 surveys with Puerto Rican fishers to explore aspects of fishers' subjective perceptions of environmental and climate change and investigate factors influencing these perceptions. Our findings show that fishers perceive the local environment and climate to have undergone significant changes in the past couple of decades and they believe these changes have been affecting the fishery and consequentially leading them to adapt. Adaptations to these impacts, which consist mostly of seeking new fishing grounds, have led them to increase their exposure to risks, particularly among SCUBA divers fishing in deeper waters and farther away from the coast. Results also show important relationships between fishers' perceptions of the status of fishery resources, demographics, levels of environmental awareness, and concern about climate change. These findings have significant implications for the development of policy and educational strategies aimed at increasing sustainability and well-being in fishing communities.

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2.1 Introduction

Marine ecosystems and resources worldwide are being transformed and threatened by human activity at an increasing pace. In the Caribbean region, economic development and population growth have generally occurred without effective policies to safeguard the sustainability of natural resources, resulting in rapid degradation of coastal waters and critical ecosystems (Valdés-Pizzini et al. 2012). Ecological deterioration and overexploitation and overfishing have contributed to the collapse of many important fishery resources in the region, reducing biodiversity, revenues, and the resilience of fishers, their families, and communities. Marine fisheries in the Caribbean are also vulnerable to a wide range of climate change impacts. Among the most significant are loss of critical habitat such as mangrove forests and seagrass beds (Short et al. 2016; Alongi 2015), coral bleaching and disease (Baker 2014; Randall and Woesik 2015), changes in patterns of freshwater flows (Holding and Allen 2015), and ocean acidification impacting shell formation for corals, plankton, and shellfish (Rhein et al. 2013). Climate change impacts also affect the life cycles, abundances, and distributions of fish species (Perry et al. 2005). Fishing is an important cultural and socioeconomic component in the Caribbean context. Understanding factors impacting and transforming this activity from the viewpoint of those directly involved, that is, the fishers, is crucial for developing strategies that will maximize coastal communities' resilience and adaptation to change in the region, particularly under future climate change scenarios. This study uses data collected from surveys with Puerto Rican fishers to explore aspects of fishers' subjective perceptions of environmental and climate change and investigate factors influencing these perceptions.

2.1.1 Climate Change and Fisheries

In fishing communities, direct and indirect impacts of environmental degradation and climate change on species that are important for income and subsistence affect the ability of fishers to harvest them (Sumaila et al. 2011; Pinsky and Mantua 2014; McCay et al. 2011; Allison et al. 2009; Weatherdon et al. 2016) resulting in reductions in revenue and food security. Declines in revenue impact fishers and their families as well as local economies by negatively affecting supporting businesses such as seafood dealers and distributors, fish markets, and restaurants and associated sectors such as tourism. Impacts on the ability of fishers to catch fish for their subsistence result in reduced food security. In small-scale fishing communities, and as evidenced in Puerto Rico (Garcia-Quijano et al. 2015; Griffth and Valdés-Pizzini

2002), it is common practice for fishers to give a portion of their catch to family and other community members. Thus, reductions in catch also affect practices that foster the development and maintenance of social ties that are important for generating social capital. Natural resource decline also influences changes in fishery management, for example, prompting reduction of allowable catches and extended closures, contributing to pressures associated with resource scarcity and further affecting fishing communities' socioeconomic well-being. In addition, from a human dimensions perspective, fishing communities are typically located in low-lying zones which are at risk from sea level rise and present high exposure to extreme weather events (Nicholls and Cazenave 2010), potentially compounding their socioeconomic vulnerability under climate change.

Transformations associated with environmental and climatic change and the potential impacts of indirect effects on range and productivity of commercially important species require that fishers adopt strategies to respond adaptively. Adaptive responses may include *within-fishing* adaptations, for example, finding new fishing grounds and exploiting different species, or *outside-fishing* adaptations, that is, finding alternative income or employment (Pinsky and Mantua 2014; Cinner et al. 2011; McCay et al. 2011). Poverty and other types of marginalization in fishing communities may reduce the ability of fishers to adapt to changes (Daw et al. 2009), particularly through *outside-fishing* adaptations. In addition, a great deal of research suggests that fishers are reluctant to leave the occupation of fishing even under economic hardship due to a combination of sociocultural and psychological factors (Smith and Clay 2010; Pollnac et al. 2015). Job satisfaction in fisheries has long been recognized as an important aspect related to fishers' adaptation to change (Pollnac and Poggie 1988). Although satisfaction with aspects of one's job is important in any occupation, it is especially significant in fishing jobs. Among fishers, the structure of job satisfaction includes attributes of "adventure," "challenge," and "being outdoors" that are infrequently found in other occupations (Apostle et al. 1985; Pollnac and Poggie 1988, 2008; Binkley 1995; Pollnac et al. 2008; Seara et al. 2017a, b). Understanding these satisfactions derived from fishing is important because the more attached people are to their jobs, the more difficult it is to either leave or deal with significant changes to their occupation. For people presenting strong occupational attachment, the prospect of losing their jobs may represent not only the loss of income but of part of their self-identity (Marshall et al. 2007). Therefore, leaving the occupation of fishing altogether as an adaptation strategy is unlikely and of particular concern for individual, familial, and community well-being (Pollnac and Poggie 2008; Pollnac et al. 2015). In a detailed ethnography of Puerto Rican fishers, Griffith and Valdés-Pizzini (2002) describe that a great deal of them consider fishing as "therapy." Many Puerto Rican fishers who work on land jobs (e.g., farming) during the fishery off seasons return to the sea, to what they describe as a healthy activity that keeps their minds occupied on useful things and that provides relief from stress (Griffith and Valdés-Pizzini 2002). In a study comparing Southeast Puerto Rico and other fishing communities in the USA and the wider Caribbean region, Seara et al. (2017b) found that Puerto Rican fishers presented the highest levels of job satisfaction among compared samples. The authors

argue that high job satisfaction among Puerto Rican fishers is associated with freedom to pursue their own inclinations in fishing and other livelihood activities and spend time with friends and family, coupled with a sufficient material well-being and strong social ties within their communities (Seara et al. 2017b). Therefore, changes resulting from climate change and other anthropogenic impacts affecting the fisheries in Puerto Rico will have significant impacts on the psychological and social well-being of fishers and their families. According to Daw et al. (2009), "climate change impacts on fisheries will occur in the context of, and interact with existing drivers, trends and status of fisheries." Specifically in Puerto Rico, evidence of the significance of fisheries to economic, cultural, psychological, and basic subsistence aspects further emphasizes the challenges associated with fishers' adaptation to environmental and climate change.

2.1.2 Puerto Rico Fisheries

Fishing activities in Puerto Rico are predominantly dependent on nearshore coral reef systems (Appeldoorn 2008) and adjacent ecosystems such as seagrass beds and mangrove forests. Coral reef ecosystems in the Caribbean have been declining for at least the last 40 years, although pinpointing the beginning of the decline has been difficult (Appeldoorn et al. 2009). Overfishing and climate change are considered two of the most significant threats for the great majority of Puerto Rico's reefs and marine ecosystems (García-Sais et al. 2008; Rogers 2009; Ramos-Scharrón et al. 2015; Loh et al. 2015; Hernández-Delgado et al. 2014). In 2005, a widespread coral bleaching event associated with record high seawater temperatures in the Caribbean region heavily impacted Puerto Rico's coral reefs (Wilkinson and Souter 2008). Following the bleaching event, researchers in the region reported an average of 50% decline in live coral cover and up to 90% mortality of coral colonies at specific monitoring sites (Miller et al. 2006; García-Sais et al. 2006; Woody et al. 2008). Donner et al. (2007) attributed this particular event to anthropogenic warming. The study suggests that greenhouse gas emissions increase the probability of events of extreme thermal stress in the region by an order of magnitude, which could result in events, such as the one that occurred in 2005, becoming biennial occurrences within the next 30 years (Donner et al. 2007). The authors further stated that expected increase in hurricane activity in the region, also as a result of human-induced climate change, would critically damage and endanger corals already weakened by bleaching events (Donner et al. 2007). The 2017 Atlantic Hurricane Season (AHS) was one of the most active in history producing six hurricanes above category 3 and breaking the record for most consecutive storms in the satellite era (NOAA 2018a). The most intense hurricane of the 2017 season, category 5 Maria, made landfall in Puerto Rico in September and was the most intense storm to hit US territory in recorded history (NOAA 2018a). The 2017 AHS, particularly the two most intense storms Irma and Maria, caused catastrophic damage to Puerto Rico communities and resulted in substantial damage to the island's shallow water coral reefs (NOAA