

# Case Studies

*Water-Ecosystem Services, Drought, and Environmental Justice:*

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# **Living with thirst: People and wildlife in southern Africa's variable climate**

## ***Southern Africa***

**Anna Cathey**<sup>1</sup>, Andrea Gaughan<sup>2</sup>, Bill Kanapaux<sup>3</sup>, Gregory Parent<sup>4</sup>, Deborah Wojcik<sup>5</sup>

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### **Summary:**

Southern Africa is a region of arid and semi-arid environments that endures wide fluctuations in seasonal and annual precipitation. Proximity to perennial water sources is extremely important and influences nearly all facets of life, from drinking water to livelihood activities. The threat of climate change has important implications for both humans and wildlife in the region. Global climate models agree on warming trends across southern Africa, but models are inconsistent with regard to precipitation. While rainfall variability is a natural component of dryland environments, this constant variability, coupled with uncertainty about future trends, is cause for concern. This case study will investigate how changes in climate variability may affect the strategies that people use to cope with drought.

*Photo: A savannah in Savuti, Chobe National Park, Botswana*



# **Ecological futures are bleak for aquatic biota in a western Great Plains river basin subject to groundwater pumping and drought**

*Arikaree River, Yuma County, Colorado USA*

**Jeff Falke**<sup>1</sup>, Kurt Fausch<sup>1</sup>, Julie Scheurer<sup>2</sup>, Robin Magelky<sup>3</sup>, Angela Aldred<sup>3</sup>, Deanna Durnford<sup>3</sup>, Linda Riley<sup>3</sup>, and Ramchand Oad<sup>3</sup>

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## **Summary:**

We conducted an eight-year interdisciplinary study among fish ecologists, groundwater hydrologists, and irrigation engineers on how drought and agricultural irrigation affect aquatic habitats in the Arikaree River, Colorado, a groundwater dependent stream. Our overall goals were to forecast ecological futures for native stream fishes under different pumping and drought scenarios, and make conservation and management recommendations for sustaining both biodiversity and agriculture. We found that despite water conservation practices, groundwater levels have declined and aquatic habitats have become reduced and fragmented, reducing aquatic biodiversity. Declines in stream flows from irrigation pumping are not limited to the Arikaree Basin, but are widespread across the western Great Plains. Given these dire circumstances, conservationists need to locate suitable refugia in other basins for translocating native fish species to maintain biodiversity, before habitats dry permanently.

*Photo: Sandy Bluffs State Trust Land, Arikaree River, Yuma County, Colorado*



# Trade-off in drought: Perceptions of need and injustice in water distribution in Australia

*The state of Victoria, Australia*

**Catherine Gross<sup>1</sup>**

<sup>1</sup>PhD Scholar, The Australian National University, Canberra, Australia

## Summary:

Following extended drought conditions in south-eastern Australia, the Victorian State government embarked on a large-scale infrastructure project to address urban water shortage in the state's capital. This was combined with a significant upgrade to the ageing irrigation infrastructure in the state's north. However, a broad-based grassroots movement opposed the combined project citing a range of issues that included the transfer of water out of a water-stressed area to a city believed to have other options, the construction of a 75 kilometre pipeline and a lack of detailed information about the project. The case study explores this social conflict from a justice perspective and found widespread perceptions of injustice. The case study shows not only that justice is fundamental to people's acceptance or rejection of a decision but also why it is important.

*Photo: Sign at site of proposed pumping station on Goulburn River, Victoria, October 4, 2008*



# **Synergies and tradeoffs: Managing land to improve water supply in Kona, Hawai'i**

***Kona, Hawai'i***

***Kate A Brauman***<sup>1</sup>, Gretchen C Daily<sup>2</sup>, and David L Freyberg<sup>3</sup>

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<sup>2</sup>Department of Biology and Woods Institute for the Environment, Stanford University

<sup>3</sup>Department of Civil and Environmental Engineering, Stanford University

## **Summary:**

Ensuring adequate drinking supply has come to the forefront of planning and environmental decision-making in Kona, Hawai'i as steady population growth in coastal areas pushes the limits of the freshwater supply. While traditional Hawaiian watershed management considered the continuum of ecosystems between the mountains and the sea and governed them as a single unit, a necessity in a place where the lowlands are dry and rain falls in upland areas, modern landholdings divide watersheds into parcels, separating water users from water sources. We are exploring the different ways native forest and working pasture affect downstream water availability to determine the economic value of those ecosystems for water supply. In some instances there are co-benefits of carbon sequestration, habitat maintenance that supports endemic biodiversity, timber and non-timber forest products, and use by Native Hawaiians for cultural resources; other situations require choices to be made among these services.

*Photo: Pasture with Hualalai Volcano in the background, Kona, Hawai'i. By Kate Brauman*



# **Managed and un-managed drought: A case study in Owens Valley, CA**

***Owens Valley, Inyo County, CA***

***Daniel Pritchett***<sup>1</sup> and Sara J. Manning, Ph.D.<sup>2</sup>

<sup>1</sup>Bristlecone Chapter, California Native Plant Society

<sup>2</sup>Big Pine Paiute Tribe of the Owens Valley

## **Summary:**

In 1991 Inyo County and Los Angeles attempted to end their historic conflicts -- as well as decades of litigation -- over Los Angeles' water exports by signing the Inyo-LA Long Term Water Agreement (LTWA). Under the LTWA, Los Angeles obtains Owens Valley water, in part, by imposing managed groundwater drought (several-year cycles of pumping-induced water table drawdown and recovery). What happened when application of this management practice coincided with severe climatic drought? We will examine a 21 year record of conditions in two adjoining groundwater-dependent meadows as a vehicle to discuss some of the ecological, social, and political consequences. The legal framework of the LTWA may be unique to California, but the issues involved are common to inter-basin transfers elsewhere, especially those between political entities with asymmetric power relationships.

*Photo: Owens Valley dust storm: excessive groundwater withdrawals lower vegetative cover and lead to blowing dust. By Daniel Pritchett*



# **Perceptions and realities of changing water availability: Adapting to climate change in the Peruvian Andes**

*Peruvian Andes*

***Katherine W. Dunbar***<sup>1</sup>

<sup>1</sup>University of Georgia

## Summary:

This paper investigates how conceptualized and measured impacts of climate change are related to perceptions of water scarcity, water use practices, and the trajectory of water management policies within the Andean highlands. The social and ecological dimensions of water availability are integrated by engaging with community perspectives on changing water management needs, views of scientists and practitioners responsible for monitoring environmental change, academic literature detailing glacial change and fluctuations in stream flow, and forthcoming national policy documents for adaptation to climate change. These diverse messages provide a rich discussion on the vulnerability of and potential for adaption among highland populations to changing water availability.

*Photo: View of Copa Glacier from the plaza of Copa Grande*



# **Upstream-downstream water-use conflicts in the Apalachicola ecosystem**

## ***Apalachicola-Chattahoochee-Flint River Basin (Georgia, Alabama, Florida)***

**Laura E. Petes<sup>1</sup>**, R. Todd Engstrom<sup>1</sup>, J. Kevin Craig<sup>1</sup>, Andrew J. Smith<sup>2</sup>

<sup>1</sup>Florida State University Coastal & Marine Laboratory, St. Teresa, FL

<sup>2</sup>Apalachicola Riverkeeper, Apalachicola, FL

### **Summary:**

Like many watersheds around the world, the Apalachicola-Chattahoochee-Flint River Basin, one of the largest in the eastern United States, is being threatened by drought and human modification of river flow. Recent, severe drought in the southeastern United States has intensified inter-state water conflicts, with Georgia demanding additional withdrawals to support municipal and agricultural water needs, while Florida demands sufficient flow to maintain the integrity of ecologically- and economically-important downstream ecosystems. The Apalachicola River watershed has been identified as a “biodiversity hotspot,” with over 1,500 native species, many of which are endemic or rare. Downstream, Apalachicola Bay supplies 90% of the oysters for the state of Florida and 10% of the oysters for the entire United States. When freshwater input to the Bay decreases, oyster mortality increases due to a combination of diseases and predators that thrive in high salinity. As concerns mount over the consequences of global climate change and continued population growth, conflicts over water are likely to intensify, making effective water resource management increasingly difficult.

*Photo: Apalachicola River estuary, Florida. By Earl Morrogh*



## **Challenges and opportunities in the management of a multi-year drought in South Florida (2006 -2008)**

**R. Thomas James**<sup>1</sup>, Cynthia Gefvert<sup>1</sup>, Paul McCormick<sup>1</sup>, Christian Davenport<sup>2</sup>, Wossenu Abtew<sup>1</sup>, Ashie Akpoji<sup>1</sup>, Veronica Anderson<sup>1</sup>, Matahel Ansar<sup>1</sup>, Louis Cadavid<sup>1</sup>, Kim O'Dell<sup>1</sup>, Jesus Rodriguez<sup>1</sup>, Dave Unsell<sup>1</sup>

<sup>1</sup>South Florida Water Management District, West Palm Beach, FL 33411

<sup>2</sup>Palm Beach County Archaeologist, West Palm Beach, FL

### **Summary:**

From October 2006 to August 2008, a record-breaking drought in south Florida depleted water supplies, resulting in environmental, economic, and social harm. Lake Okeechobee, which provides water through much of the region, reached historic low water levels. Groundwater levels declined, increasing the threat of saltwater intrusion into well fields that are primary sources of drinking water for coastal urban areas. This drought required a proactive, region-wide response involving specialized teams from the South Florida Water Management District and government agencies working with utilities, residences and businesses to manage and conserve water. The drought provided opportunities for archaeology, biological restoration, and flood control enhancements. Communication and coordination among stakeholders were critical in responding effectively to this drought. By exploring alternative water sources and using water wisely both the environment and economy of south Florida will flourish.

*Photo: Lake Okeechobee viewed from boat lock S-135 during the multiyear drought.*



# **Paradoxes in adapting to droughts: The rationality of locality**

## ***Bear River Basin of Idaho, Utah and Wyoming, USA***

**Joanna Endter-Wada<sup>1</sup>**, Lisa W. Welsh<sup>1</sup>, Rebekah Downard<sup>1</sup>, and Karin Kettenring<sup>2</sup>

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### Summary:

The Bear River flows for 500 miles through a highly variable, snow-driven, drought-prone montane ecosystem in the arid region of the western United States. It traverses three states, is diverted to store water in an ecologically unique natural lake (Bear Lake), and empties into the Great Salt Lake at the Bear River Migratory Bird Refuge. People in the Bear River Watershed came to anticipate droughts, building a legal, institutional, and engineered infrastructure to adapt to the watershed's hydrologic realities and historical legacies. Their ways of understanding linked social-ecological vulnerabilities has led to seemingly paradoxical outcomes ... irrigation of wetlands like farm fields, USFWS support for dams, wetlands without water rights having a more secure water supply than wetlands with water rights, and farmers without reservoir storage being less vulnerable to drought than farmers with storage and the oldest rights on the river. We argue that there is a contextualized rationality involved in the way people have organized their relationships with the environment and with each other in that locality which helps to explain these paradoxes.

*Photo: Bear River seen from the Wellsville Mountains as it flows through Cache Valley. By Rebekah Downard*



## **Deserted: Forgetting nature, humanity, and history in the Salt River Bed**

**Colleen Strawhacker**<sup>2</sup>, Bethany B. Cutts<sup>1</sup>, Kate J. Darby<sup>2</sup>, Rebecca Hale<sup>1</sup>, Elisabeth K. Larson<sup>1</sup>, Adam Thorman<sup>3</sup>

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### **Summary:**

This video will highlight the dialectic relationship between humans and the rivers. In this project, we will 'remember' relationships and processes that Phoenix residents tend to forget, including a selection from the following: previous attempts to control the rivers, the natural cycles of drought and flooding on the rivers, the continual displacement of marginalized people from the rivers' edges, our dependence on the ecosystem functions provided by the rivers, and the aesthetic of an unmediated desert riparian ecosystem. Drawing on the strengths of our participants (biogeochemistry, ecology, archaeology and environmental justice), we compare two dichotomous examples of interactions with the Salt River in the Phoenix Basin – Allenville and Tempe Town Lake – to highlight the diverse set of consequences, benefits, and responses at the interface of a desert river and human communities.

*Photo: South El Mirage Rd crosses the Salt River just west of the Phoenix International Raceway, near Allenville after 2008 winter floods. By Adam Thorman*



## The Water Front: A powerful environmental justice story

### *Highland Park, Michigan*

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#### Summary:

*The Water Front* ([www.waterfrontmovie.org](http://www.waterfrontmovie.org)) is a feature documentary film that follows one of the first water battles playing out in the United States from an environmental justice perspective. Residents of Highland Park, known as the birthplace of the auto-industry, have received water bills as high as \$10,000; they have had their water turned off and are in the midst of a ongoing struggle to keep their water from becoming privatized. The film follows one woman's struggle to organize a grassroots campaign to defend affordable water as a basic human right. The film challenges the concept that water scarcity is simply a question of physical availability and demonstrates that water scarcity is rooted in the politics of race, class, and poverty. *The Water Front* contributes to timely debates regarding water, democracy, and urban ecology and is an unnerving indication of the challenges that cities around the world will be facing.

*Photo: Highland Park, Michigan. One way that cities or private management companies "cut corners" is to put off repairs of fire hydrants. Still from "The Water Front" movie. By Liz Miller.*



# Adaptations to extreme droughts and floods: Learning to sustain southeastern freshwater ecosystem services through regional comparisons

## Southeastern United States

**Alan P. Covich**<sup>1</sup>, Amber Ignatius<sup>2</sup>, Kyle McKay<sup>1</sup>, Julie McEntire<sup>1</sup>, Ted Gragson<sup>3</sup>, Steve Golladay<sup>4</sup> and Steve Opsahl<sup>4</sup>

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<sup>3</sup>Anthropology Department, University of Georgia, GA

<sup>4</sup>Joseph W. Jones Ecological Research Center, GA

### Summary:

Predicted increased variability in rainfall together with the effects of fast-growing population centers, hydropower development, and irrigated agriculture will likely continue to alter landscape and biotic diversity of freshwater ecosystems in the Apalachicola-Chattahoochee-Flint (ACF) River Basin in Alabama, Georgia and Florida. Adaptations to these climatic changes among water users provide examples of how water can be spatially distributed to protect in-channel habitats and biodiversity as well as to supply predictable water for socio-economic needs during periods of highly variable precipitation. Within the ACF and other regions, individuals rely on combinations of groundwater and surface water storage to sustain for ecosystem services in differently sized sub-basins with distinct land uses. Exponential increases in numbers of farm ponds and reservoirs constructed over the last 50 years provide basin-wide adaptations that are valuable during periods of both high and low precipitation. The cumulative and linked effects of these storage systems are likely to go undetected if large and small reservoirs are studied as independent units within a drainage network. Governmental efforts, such as the Flint River Drought Protection Act and other incentives, provide examples of additional adaptive responses to extreme variations in precipitation that sustain flows in rivers with high biodiversity and essential ecosystem services. Comparative studies among regions with different precipitation regimes improve our understanding of how socio-economic adaptations such as constructed ponds and lakes have transformed the landscape and altered the biodiversity essential for sustaining freshwater ecosystem services.

*Photo: The Flint River, Georgia.*

