Adriana Garriga-López

Agua Dulce

Puerto Rico is composed of several sub-tropical islands in the eastern Caribbean. Sources of fresh water in Puerto Rico are abundant.[1] Hundreds of rivers, springs, and lakes are part of its ecosystem, which includes urban, rural, suburban, and industrial areas, as well as wild and managed rainforests, wet forests, cloud forests, unique dry forests, brackish mangroves, and other coastal areas. While the climate is mostly humid, a regular dry season during spring and summer months often includes droughts. When this occurs, water reservoirs are usually able to meet the large industrial and residential demand, yet droughts have recently led to more frequent water rationing, as they did in 2015 (from May to September) and 2018. 2019 has been a year of prolonged drought. Water levels in reservoirs were low early in the year, and by the beginning of July, extreme drought had officially been declared by the US Drought Monitor and the Puerto Rican government for ten out of the island's seventy-eight municipalities (mostly in the southern part of the big island and Vieques, where increased wildfires are also being observed), with dozens of other towns experiencing moderate drought due to lack of rainfall.[2]

In a 2017 report, the Natural Resources Defense Council found Puerto Rico's rate of drinking water standards violations to be the highest in the US, with 99.5% of the population served by community water systems in violation of the Safe Drinking Water Act (SDWA).[3] Most of these violations were the result of simply failing to test water, yet overall, piped water quality has been negatively affected by decreased monitoring and budget cuts.[4] These cuts reflect Puerto Rico's financial crisis and the current regulation of public resources under the regime of financial austerity created by the Federal Oversight Board (known locally as *La Junta*), which was established in 2016 by the US federal government's PROMESA (the Puerto Rico Oversight, Management, and Economic Stability Act).[5]

Under the debt-restructuring mandate of this legislation, the Federal Oversight Board has begun implementing a plan to privatize the Puerto Rico Aqueduct and Sewer Authority (PRASA). Attempts to privatize PREPA began in the late 1980s and intensified in the early 1990s but have been unsuccessful, due at least in part to significant protests and public outcry. However, there were also serious problems with the privatization schemes, which involved having Professional Services Group (PSG), a Minnesota-based subsidiary of Veolia with no prior experience in Puerto Rico, take charge of management and logistics. Severe management issues and breakdowns in communications with PSG led to the re-municipalization of the system in 2002 and the rescinding of the contract.[6] Despite the failure of these previous attempts and continued public outcry against associated neoliberal policies, there is now a renewed push for privatization by the Federal Oversight Board.[7] Although the system's overall state of disrepair is generally seen as a drawback for potential investors, privatization is promoted as the

Roadside water source in Adjuntas, Puerto Rico. Photo: Adriana Garriga-López.

only avenue for improvement contemplated. Meanwhile, deterioration of the infrastructure has hastened corrosion, leading to widespread loss (up to 65%) as water seeps through old, leaky pipes and connections.[8]

People in Puerto Rico who live in structurally marginal areas, or whose dwellings are not up to code, sometimes set up illegal or informal connections to water sources for personal use by linking commercially available small pipes to public water infrastructures or by creating their own independent water infrastructures. Some informal connections may be approved by local officials while not being officially sanctioned by the water utility. Others are simply hidden. This makes it difficult to grasp the piped system's complete form and complicates updates. These informal connections are often cited by government officials as playing a large role in systemic water loss, but because of the fugitive nature of the connections, it's hard to know the true extent of the problem.

Most of the people who depend on these fugitive water pipes are effectively squatters, living on what is often referred to as rescued or reclaimed land, created out of mangroves, flood zones, or canals that have been filled in with trash and debris.[9] The residents are Puerto Ricans and also immigrants (mostly from Haiti and the Dominican Republic) or their descendants. The land some live on has been given to them by local officials. For others, it has been inhabited by generations of their family without anyone having the land title or the means to secure a copy. This situation of titlelessness is common for Puerto Rican families, and is one of the problems people encountered following Hurricane Maria when trying to apply for assistance to rebuild their homes. FEMA requires evidence of ownership to disburse rebuilding funds, and as of July 2018, 79% of claims sent to FEMA had either been denied or were still waiting for a response.[10]

Thinking critically about property ownership as part of understanding these fugitive water systems requires

looking differently at inter-island migration in the Caribbean, as well as Puerto Rican land (and water) politics in relation to the history of imperialism. Since 1493, when Christopher Columbus claimed these islands for Spain thinking he was near India, they have been a haven for outlaws and revolutionaries. This includes indigenous and black people who escaped from slavery by sailing to other islands or running away to the central highlands.[11] They were known as *cimarrones*, and c *imarronaje* (or *marronnage*) was the practice of stealing oneself away from colonial power; running toward freedom individually or as a group, and creating new societies known as *palenques*.[12] While there are stark historical differences (such as the end of chattel slavery) between palenques and contemporary urban or peri-urban neighborhoods where the poorest and most marginalized people live in Puerto Rico, there are also racialized continuities of struggle against colonial state power and shared modes of survival on the edges of empire. What would it mean to decolonize water infrastructures and access to drinking water? Instead of applying legalistic, statist, imperialist, or normative ways of resolving the problem of differentiated water access and inequality, what kinds of knowledges, practices, and perspectives are mobilized by "illegal" or fugitive water use? Understanding water use in marginalized areas as examples of afro-indigenous, migrant, or autonomous community structures centered on land reclamation for colonized people rather than as illegitimate socialities and appropriations of public goods can begin to reveal the "hidden geography of Puerto Rican waterscapes" as they articulate through gendered, racialized, and classed regional dynamics in the wake of slavery and the plantation.[13]

While there are obvious potential problems associated with a lack of quality regulation common to informal water systems, there is also evidence suggesting that water sources not connected to Puerto Rican state infrastructure, but rather under community control, are often of better quality.[14] Water activists and scholars have insisted for decades that the centralization of access through massive infrastructure is not the right approach for Puerto Rico's geography and culture.[15] As with the electric system, decentralization (meaning a more localized approach) is a good alternative to large-scale, centralized infrastructure, as it allows for more environmentally responsive construction in ecologically sensitive areas.[16] Putting infrastructure under community control could also generate a sense of ownership among its members and increase accountability, highlighting the need for responsible water and energy management among both individual and corporate consumers.

Public discourse about so-called "water theft" or illegal water connections tends to criminalize poverty rather than highlighting irresponsible corporate practices, which actually create much greater pressure on water systems. Punitive measures like increased jail time and fines for water theft are called for and authorized, while the ecological impact on local watersheds of suburbanization and housing development schemes that rely on large public infrastructures goes largely unexamined.[17] Public discourse also demonstrates the calcification of social thought around water as something the government provides, rather than something that exists and can be interacted with freely. Yet, many rural or semi-rural communities defy this logic of massive infrastructure and state capture. For some, direct access to water was crucial to surviving the weeks and months after the 2017 hurricanes.[18] During the recovery-related outreach in the months after Hurricane Maria, some people in remote or mountainous areas were found to have been living without piped water not just for months, but for decades.

Destructive Forces

Hurricanes Irma and Maria had major repercussions for the complex Puerto Rican water system, including the washing out of nitrates from forest land into water ways (a result of deforestation), and the collapse of many small infrastructures in remote and rural areas.[19] Hurricane Maria also transformed the landscape and ecology of the islands, including the physical shape of rivers, dunes, shores, and forests.[20] The effects were far from being just the result of natural phenomena, however. Deterioration played a central role in the failure of the Guajataca Dam (built in 1929) after Hurricane Maria moved through northwestern Puerto Rico. Cracks in the structure appeared and the overflow release mechanism was overrun by water. With failure imminent, authorities decided to open the dam and release part of the water into the Guajataca River. While this decision may have staved off a worse outcome that would have occurred had the dam fully burst, the flood that resulted claimed the lives of several people who drowned in the area downriver. In fact, most of the people who drowned during and immediately after the passage of Hurricane Maria were from the area affected by this dam release. While it has now been repaired, the Guajataca dam and other critical water structures like it are threatened by deterioration, mismanagement, and the intensifying effects of climate change, such as prolonged drought and larger quantities of rain falling in shorter amounts of time.

Social differences affect the way people access and use water, including differences in class, race, gender, and national origin. In addition, research has shown that the privatization of water systems usually leads to a decrease in water quality and an increase in cost for residents, especially for those who wield less influence over political decisions.[21] In her research on water use and drought in Los Angeles, anthropologist Jessica Cattelino argues that gender intersects with class, race, and citizenship to shape residential water use.[22] This analysis of how power shapes water security in urban settings draws attention to

Río Pellejas in Utuado, Puerto Rico. Photo: Wikimedia Commons/Ian Poellet.

the easily overlooked differential effects of water shortages as they manifest in highly stratified contexts. For example, in the months after Hurricane Maria, Puerto Rican women felt the brunt of the lack of running water, as they were largely responsible for managing water-dependent household tasks like cooking, cleaning, and clothes washing.[23]

The challenges posed by climate change in the Caribbean are severe and have implications that are difficult to comprehend in their full complexity. The agricultural sector is highly sensitive and vulnerable to the effects of drought; people who work the land can directly observe the growing impact of reduced water availability in their environments. This means less rain, with creeks and rivers drying up, and less predictable flooding. In late June 2019, the Puerto Rico Department of Agriculture announced economic incentives totaling one million dollars to help cow, sheep, and goat ranchers mitigate the effects of water shortages on the industry.[24] But incentives did not extend beyond these industries to vegetable or fruit farms, even though these are much more sustainable industries in Puerto Rico than water-intensive cow and sheep farming. These changing conditions could lead to far-reaching negative effects not only on the Puerto Rican economy but also on nutrition and the habitability and stability of communities around the island—especially those in areas most dependent on subsistence agriculture.

Increasingly dry conditions on island hillsides will create more fire-prone environments in rural areas, as projected in the report of the Fourth National Climate Assessment published by the US federal government (and disavowed by the executive branch).[25] These projections describe increases in both drought and wildfire as significant climate change–related effects already taking place in the Caribbean region. This trend of increasing drought has been around at least since the 1990s, but is intensifying.[26] The future likely holds more extended drought conditions

alternating with severe floods, which will continue to put pressure on the already faltering water infrastructure and make wildfires more frequent, more extensive, and burn hotter.

When it comes to present paradigms of what is considered normal with regard to wildfires in Puerto Rico, it is difficult to grasp the scale of the challenges soon to be faced. Because of drought and rising temperatures, a near future in which more frequent wildfires and more extended fire seasons will become much more socially disruptive is likely.[27] In her study of wildfire science, anthropologist Adriana Petryna has noted the epistemological "horizoning work" that fire scientists and firefighters are currently finding necessary in order to respond to "runaway change" when it comes to wildfire severity and conditions.[28] This horizoning work can make possible the perception of new thresholds and thereby new strategies when it comes to living with, managing, and mitigating the effects not just of wildfires, but also of climate change more generally. What horizoning work is necessary in order for Puerto Ricans to learn to recognize new conditions caused by runaway environmental change, mitigate their impact as much as possible, and adapt—not to mention slow down the climate's rate of change in the first place?

There are major ecological adjustments ahead for Puerto Rico. By the middle of the current century, "all life zones in Puerto Rico are projected to shift" from rainy and wet zones to significantly drier tropical zones.[29] This means a drastic reduction in ambient water available for use. In addition, while temperatures in the capital city of San Juan have already increased 1.5°F since 1950, "historically unprecedented warming" to between 2°F to 5°F is projected to occur in the Puerto Rican environs by the year 2100, with increased frequency of extreme heat events.[30] These shifts imply huge consequences for bio-diversity and species distribution on land and in the water, as well as for agricultural production and human potable water systems.[31]

Further, in 2014, a report by the US Department of Agriculture and the US Forest Service stated, "tourism and recreational opportunities may change with an increase in extreme weather and impacts from sea level rise."[32] Yet tourism continues to be at the heart of economic development plans for the islands. The tourism industry places significantly heightened demand on water sources and increases water stress across the Caribbean. Water provision schemes privilege tourist areas and during times of water shortage or rationing, water is often available in tourist areas but not in those where permanent residents live. After Hurricane Maria, for example, touristic and touristic-adjacent zones had access to running water weeks or even months before other areas in Puerto Rico. Yet climate change threatens the very viability of touristic enterprises as increased storm frequency, damage from storms, and rising temperatures potentially reduce the number of tourists visiting the Caribbean. Sea level rise and coastal erosion also threaten to severely curtail or altogether eliminate some popular beaches. There is debate about whether these changes are permanent, but on the night in late August 2019 that a friend and I visited the famous beach of Ocean Park, five to six feet of sea was beating on the flimsy concrete wall that separated it from the street.

Since 1910, the surface temperature of water surrounding Puerto Rico and the US Virgin Islands has increased by 3°F.[33] Increasing ocean temperatures and sea level rise imply an increase in the volume and destructive power of storm surges.[34] By some estimates, sea level rise will reach almost three feet by 2060 and as much as seven feet by 2100.[35] Scholars have shown that sea level rise is actively threatening the survival of important cultural heritage sites in Puerto Rico, including some of the most popular touristic sites.[36] In addition, research conducted by Puerto Rican anthropologist Isabel C. Rivera-Collazo shows that coastal archeological sites were severely affected by Hurricane Maria's storm surge and that prediction models largely underestimated the damage, including a desk-based vulnerability assessment of Puerto Rico's cultural heritage that Rivera-Collazo herself conducted in early 2017 (pre-Maria and Irma) that actually accounted for sea level rise.[37] Research also points to sea level rise, saltwater intrusion, and coastal erosion as important factors in the salinization of fresh water resources in the context of highly porous karst aquifers in the north, with potentially serious negative health effects in both human and animal populations.[38] In southern Puerto Rico, salinization already threatens the viability of aquifers.[39]

As cyclones continue to develop at a faster rate and with greater intensity in the Atlantic basin, water stress and concern over potential water insufficiency and access to water are palpable among the population. For example, when millions of expired water bottles worth $22 million (paid for by FEMA) designated for hurricane victims were discovered abandoned on a runway in the old Roosevelt Roads naval base in Ceiba in September of 2018—one year after Hurricane Maria—there was widespread indignation among Puerto Ricans who had lived through desperate days without running water.[40] Anger over such inefficiencies contributes to a general sense that recovery efforts were botched.

One important aspect of public life in Puerto Rico is that the Puerto Rican Constitution designates all beaches and coastal areas within thirty feet of the sea as public lands. These areas are also important sources of food and sustenance for coastal foragers and fishers.[41] In turn, these fishers and foragers are often themselves also the caretakers of the natural resources (such as coral reefs) that they depend on.[42] But for local populations, the construction of obstacles to the enjoyment of coastal areas, or even the complete loss of coastal access is

increasingly becoming a reality as coastal erosion, dune destruction, and tourism-oriented development have led to privatization, beach reduction, increased costs for recreational use, and significant habitat loss for flora and fauna.

These changes were already occurring before Hurricanes Irma and Maria struck in September of 2017, but these storms intensified and accelerated them.[43] The impact of Irma and Maria transformed Puerto Rican society and left many people scrambling for water to survive. Much writing on the crisis that followed these hurricanes has focused on the impact of the lack of electricity for many months. However, many people outside of metropolitan areas also lived without running water for long periods, in some cases up to eight months or more.[44]

Contamination also poses serious risk to the health of waterways in Puerto Rico. There are more than twenty heavily contaminated Superfund sites located on the group of islands that comprises Puerto Rico, evidencing the density of hazardous materials present from industrial to military remnants that contaminate local water sources with toxic substances and heavy metals.[45] These Superfund sites became salient in the aftermath of Hurricane Maria, as news reports showed that contaminated wells were tapped for drinking water during the desperate days that followed.[46] Yet they are not the only chemical danger present. For example, testing of delicate karst aquifers has shown extensive historical contamination by harmful chemicals with the potential for long-term exposure in the north of the main island, and the presence of highly polluting sediments coming from toxic coal ash in the south.[47]

For the past ten years, the US company AES has been dumping toxic coal ash in local dump sites in Puerto Rico after having been pushed out of the Dominican Republic, where they were held responsible for the contamination of entire communities.[48] AES has met stubborn and persistent resistance from residents in Puerto Rico. Public outcry against the company has continued both on the islands and in the diaspora. Recently, the Chancellor of the State University of New York hastily resigned from the board of directors of AES Corporation after targeted student protests revealed her role and investments in the company.[49]

The company's own latest report and groundwater analysis (from 2018) notes the extensive damage AES has done to the southern aquifer in Puerto Rico through the pollution caused by its chemical deposits, which local experts assert cannot be undone.[50] Since 2004, according to the Center for Investigative Journalism in Puerto Rico, two million tons of coal ash have been "discarded on the ground of twelve municipalities, without any type of protective material" to prevent toxic elements from contaminating groundwater through rain and runoff.[51] Puerto Rican residents have vigorously protested this situation for years through civil disobedience and direct action, in some cases suffering brutal repression from police.[52] Yet the Trump administration's efforts to deregulate coal ash disposal at the federal level could lend momentum to misguided plans to expand significantly the use of coal ash as filler material for roads and other public infrastructure.[53] In August of 2018, the EPA loosened regulations encompassing Puerto Rico, and as a result, AES no longer has to perform such groundwater analyses.[54] After Puerto Rico passed legislation in 2017 banning the dumping of any further coal ash deposit in island landfills, AES begun transferring the residues of their coal-based energy production in Puerto Rico to central Florida (Osceola County), which is exactly where the majority of Puerto Ricans who fled the islands after Hurricane Maria relocated.

Lastly, as the experience of many communities after Hurricanes Irma and Maria shows, water infrastructure is highly dependent on electricity in many areas on the islands. In particular, the use of and reliance on electric pumps to clear water from the streets makes getting flood water out of vulnerable residential areas and flood zones, as well as access to clean water, totally dependent on the availability of electrical power. Puerto Rico's electrical grid is completely above ground, so it is extremely vulnerable to major storm wind effects. Therefore, part of hurricane preparedness in Puerto Rico must be an analysis of alternative power sources, and means for floodwater removal and clean water availability in case of system failures like those seen in 2017 and 2018. During the height of the crisis, many people turned to rivers, springs, and lakes to supplement their most basic sanitation and household water needs. Contamination at these water sources, however, also increased their risk of exposure to diseases like leptospirosis, dysentery, E. coli, and typhoid.[55]

CNN reported that twenty-six people died of leptospirosis in Puerto Rico between September 24, 2017 and March 6, 2018; twenty-one of whom died before December 31, 2017.[56] This last number includes engineer Elizabeth Colón Miranda, who was the mother of my friend, writer Rubén Ramos Colón. Yet reports by the Center for Investigative Journalism show that due to limitations placed on case reports, like only counting cases certified by the US Centers for Disease Control and Prevention (CDC), the number of leptospirosis cases in Puerto Rico after Maria was likely much higher.[57]

Cimarrón Futures

Though these circumstances paint a dire picture, within them there are reasons to be hopeful and seek opportunities for creating a more resilient water system in Puerto Rico. One vital aspect in this regard is that the experiences people had after Hurricane Maria convinced many of the need for better, more sustainable water management practices and of the importance of creating

Agriculture in Vieques. Photo: La Colmena Cimarrona.

more dynamic systems, as well as of the need for community control over these resources. Thousands of Puerto Ricans have installed rain catchment and filtration systems in their homes, farms, and businesses since Hurricane Maria. For some, this was only possible with assistance from non-profit organizations and from donations, most of which came from the Puerto Rican diaspora.[58]

Much has also been learned and shared about the need to reduce the number of parts in water management systems that need continual replacing (like filters) as well as market dependency on specific commodities. Community leaders often highlighted the need to create systems amenable to community maintenance and shared governance of clean water sources *before* the 2017 hurricanes, and citizen coalitions continue to organize under this principle. The scenario is ripe for the cultivation of a radically different relationship to water—moving away from conventional ideals of healthy waterscapes that privilege industrially scaled water infrastructures, and toward smaller projects that center community control over renewable and shared, clean, or recyclable water sources. Future administrators of water resources in Puerto Rico can either respond nimbly to this reality or face a growing web of independent and perhaps illicit, water mini-infrastructures. Could this *cimarrón* or maroon mode of water management actually make more sense?

There is increasing awareness that industries like pharmaceuticals and biotechnology create pollution and water shortages that appear as drought conditions but are really the result of corporate-driven water use (lobbied for by groups such as the Puerto Rico Agricultural Biotechnology Industry Association, PRABIA).[59] As a result, many voters in Puerto Rico are or could be primed to support a transformation of water laws and their enforcement. With the collapse of the industrial model propped up under US colonial rule through tax exemptions for US companies, many Puerto Ricans are no longer

willing to give up control over natural resources for the supposed benefits of industrialization. Evidence is everywhere of the disastrous failure of the economic and political push under US domination toward so-called modernization by means of tax incentives for US companies and corporate capture of natural resources.[60] This old model of economic development on the island is quite literally bankrupt.[61]

The people of Puerto Rico clearly expressed an urgent need and desire for change during July of 2019, when they forced Governor Ricardo Roselló to resign after two weeks of constant protests, in large part because of his role in the corrupt fumbling of the Maria recovery. This democratic rebellion signals that the people of Puerto Rico are nowhere near ready to give up their rights to the land and water. This above all offers great cause for optimism, as do the thousands of highly trained, excellent Puerto Rican scientists whose work devoted to Puerto Rico's environment and culture spans the academic disciplines. In addition, community responses to Hurricane Maria led to the creation of large networks of water activists, residents, community organizers, foundations, and organizations committed to promoting clean water access and affordable filtration, such as the Facebook group *Water for Puerto Rico/Agua Para Puerto Rico*, which has more than 1,250 members and was re-energized after Hurricane Dorian devastated the Bahamas in early September 2019.[62]

In any case, recovery from the 2017 hurricane season for Puerto Rico has proven monumental. Monumental as well has been the effort, sacrifice, bravery, and suffering of the Puerto Rican people. Political and economic shifts may ultimately transform the relationship between the United States and Puerto Rico—either toward full incorporation in the US or toward decolonization and independence as The Republic of Borikén (or some other as-yet inexistent regional entity). Yet, the larger questions posed by environmental disruption and the consequences of climate change will be regional, affecting the entirety of the Caribbean basin, and they will not be easily solved. The paradigm of vulnerability and resilience that reigns over the disaster-industrial complex dominated by FEMA and others is not sufficient to create conditions of livability. The ways Puerto Ricans lived both before Maria and after were and are themselves too destructive, too tied up with fossil fuels and the corporate-driven destruction of the natural world.

In order to survive and thrive as Caribbean societies, island-based people must create regenerative cultures that can restore coastland, farmland, grassland, forests, mangroves, rivers, lakes, and other elements of the ecosystem that act as natural filtration systems.[63] The reclamation of ancestral knowledge heretofore rejected or disdained (including agricultural and architectural knowledges) is central to healing the environment and making it one that includes and is livable for both humans and more-than-human beings. This transformative act of rehabilitation or regeneration, both epistemological and ecological in character, is now more necessary than ever. It has been practiced by fishers, foragers, farmers, and beekeepers in Puerto Rico for hundreds of years, and lives on in farms such as *Finca Conciencia* in Vieques and in projects like the *Colmena Cimarrona*, a network of agriculturalists, beekeepers, and activists who build community solidarity through food justice, herbal medicine, and farming education projects.[64]

How can fugitive or *cimarrón* knowledges about water and food justice create a livable future for Puerto Ricans? What does a practice of water *marronage* look and feel like? Can the water structures and uses of subaltern groups bent on their own survival on the edges of genocidal states be considered guerrilla environmentalist tactics? Whatever the critical frame employed, seeking environmental justice for Puerto Ricans means empowering poor communities to use scientific and technical knowledge, valorizing subaltern knowledges about natural resources, and buttressing autonomy for women, girls, and gender non-conforming people through the reclamation and dissemination of community-based water management practices. This is not only an important feminist/queer and decolonial project, but it may also be Puerto Rico's and the broader Caribbean's only real hope at adapting to the environmental changes currently underway. Creating regenerative biosocial technologies is imperative, as is the reconceptualization of acceptable water uses and management practices toward those that support life and wellbeing for all. Ultimately, we will all be forced to learn to live differently.

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1
" *Agua dulce,"* literally "sweet water," is the Spanish-language term for fresh water in Puerto Rico.

2
Although by the start of the rainy season in August the percentage of towns experiencing drought fell from a height of almost fifteen to thirteen percent, the numbers are still alarming. EFE. 2019. "Disminuye la sequía severa en Puerto Rico de 14.67% a 13.08%," *Hoy Los Angeles*, August 1, 2019.

3
Threats on Tap: Drinking Water Violations in Puerto Rico (Natural Resources Defense Council, 2017).

4
Oliver Milman "Another Flint? Why Puerto Ricans no longer trust water after the hurricane," *The Guardian* , August 8, 2018. Adriana María Garriga-López, Alexa Dietrich, and Claudia Sofía Garriga-López "Hurricane Maria Exposes Puerto Rico's Stark Environmental and Health Inequalities," *Items* (Social Science Research Council, 2017).

5
Danica Coto, "US to cut water monitoring because of Puerto Rico debt," *Fox News*, June 10, 2016. Office of the Law Revision Counsel, "Puerto Rico Oversight, Management, And Economic Stability," *United States Code* 48, ch. 20, http://uscode.house.gov/view.xhtml?path=/prelim@title48/chapter20&edition=prelim .

6
Susana Maria Cortina de Cadenas, "Does private management lead to improvement of water services? Lessons learned from the experiences of Bolivia and Puerto Rico" (PhD diss., University of Iowa, 2011). Maia Brown, "Stopping Veolia: A Report from Seattle," *Liquid Utility* (e-flux Architecture and the Temple Hoyne Buell Center for the Study of American Architecture at Columbia University, 2019).

7
Food and Water Watch, "Water Privatization Adds Insult to Injury in Puerto Rico," 2018.

8
Diálogo, "Escasez de agua en Puerto Rico: vínculos entre la mala planificación y la sequía," University of Puerto Rico (2015).

9
Belinés Ramos Negrón and Patricia Noboa Ortega, "Comunidades sobre cuerpos de agua: ¿Quién las ayuda?," *PRTQ – Puerto Rico Te Quiero: Desarrollo en Solidaridad* , July 19, 2019

10
Nicole Acevedo, "FEMA has either denied or not approved most appeals for housing aid in Puerto Rico," *NBC News*, July 17, 2018, https://www.nbcnews.com/storyline/puerto-rico-crisis/fema-has-either-denied-or-not-approved-most-appeals-housing-n891716 .

11
Rubén Maldonado Jiménez. "A 146 años de la abolición de la esclavitud en Puerto Rico," *KaosEnLaRed.net* , March 25, 2019.

12
Glorimar Rodríguez González, "Bajo la sombra de la libertad: estudio general sobre el cimarronaje en el Caribe español durante los siglos XVI y XVII," *Alborada* 11, no. 1 (2016). For those enslaved indigenous and African people who sought to liberate themselves from the brutalities of the Spanish colonial system by means of physical escape, the islands presented opportunities in the form of interior mountain ranges that contained caves, forests, and plenty of nourishment from fish, crab, greens, and many fruits.

13
Javier Arce-Nazario, "Resilience and community pride after a hurricane: counter-narratives from rural water systems in Puerto Rico," *Alternautas* 5, no. 2 (2018): 16. On the concept of the wake see: Deborah Thomas, *Political Life in the Wake of the Plantation: Sovereignty, Witnessing, Repair* (Duke University Press, forthcoming 2019) and Christina Sharpe, *In the Wake: On Blackness and Being* (Duke University Press, 2016).

14
Arce-Nazario, "Resilience," 13–28.

15
Alejandro Torres Abreu, "¿Satisfacer o manejar la demanda? Perspectivas dominantes en torno al debate sobre el consumo de agua en Puerto Rico," *Revista de Ciencias Sociales* 20 (2009): 176–205.

16
Catalina M. De Onis, "Fueling and delinking from energy colonialism in Puerto Rico," *Journal of Applied Communication Research* 46, no. 5 (2018). Javier Arce-Nazario, "The Science and Politics of Water Quality," in Rebecca Lave, Christine Biermann, Stuart N. Lane eds., *The Palgrave Handbook of Critical Physical Geography* (Palgrave Macmillan, 2018).

17
Maricarmen Rivera Sánchez, "Tres años de cárcel por pillos de agua y luz," *El Vocero de Puerto Rico* , January 9, 2017, https://www.elvocero.com/gobierno/tres-a-os-de-c-rcel-por-pillos-de-agua/article_16b78a62-8f22-11e7-90fc-eb8298957580.html .

18
Alexa Dietrich and Adriana Garriga-López, "Small-Scale Food Production and the Impact of Water Shortages in Puerto Rico after Hurricane Maria: An Early Status Assessment," *QR* 282 (Natural Hazards Center, University of Colorado, 2018) https://hazards.colorado.edu/quick-response-report/small-scale-food-production-and-the-impact-of-water-shortages-in-puerto-rico-after-hurricane-maria .

19
Patrick Skahill, "Hurricanes Yield 'Fundamental Change' in Puerto Rico's Watershed," *Connecticut Public Radio* , December 12, 2018; William H. McDowell, William G. McDowell, Jody D. Potter, Alonso Ramírez, "Nutrient export and elemental stoichiometry in an urban tropical river," *Ecological Applications* 29, no. 2 (March 2019): E01839; and Mekela Panditharatne, "Small Water Systems in Puerto Rico Badly Affected by Maria," *Natural Resources Defense Council* (2019).

20
Hilda Lloréns, "Imaging Disaster: Puerto Rico Through the Eye of Hurricane María," *Transforming Anthropology* 26, no. 2 (2018): 136–156; Bradford C. Lister and Andrés García, "Climate-driven declines in arthropod abundance restructure a rainforest food web," *PNAS* 115, no. 44 (2018): E10397-E10406; Isabel C. "azo, "Severe Weather and the Reliability of Desk-Based Vulnerability Assessments: The Impact of Hurricane Maria to Puerto Rico's Coastal Archaeology," *The Journal of Island and Coastal Archaeology* 0 (2019): 1–20.

21
Vandana Shiva, *Water Wars: Privatization, Pollution, and Profit* (Between the Lines, 2001).

22
Jessica Cattelino, "Stakeholders, Gender, and the Politics of Water," *American Anthropologist* (2019), https://www.americananthropologist.org/deprovincializing-development-series/stakeholders-gender-and-the-politics-of-water .

23
Ana Campoy, "Hurricane Maria hit women the hardest," *Quartz,* September 22, 2018, https://qz.com/1399320/hurricane-maria-hit-puerto-ricos-women-the-hardest/ .

24
EFEUSA, "Asignan 1 millón para mitigar efectos de sequía en el ganado en Puerto Rico," *Agencia EFE* , July 2, 2019, https://www.efe.com/efe/usa/puerto-rico/asignan-1-millon-para-mitigar-efectos-de-sequia-en-el-ganado-puerto-rico/50000110-4014182 .

25
US Global Change Research Program, "Chapter 20: US Caribbean," *Fourth National Climate Assessment Report* (2018), https://nca2018.globalchange.gov/chapter/20/ .

26
Matthew C. Larsen, "Analysis of 20th Century Rainfall and Streamflow to Characterize Drought and Water Resources in Puerto Rico," *Physical Geography* 21, no. 6 (2013): 494–521.

27
Chelsea Harvey, "Here's What We Know about Wildfires and Climate Change," *Scientific American*, October 13, 2017.

28
Adriana Petryna, "Wildfires at the Edges of Science: Horizoning Work amid Runaway Change," *Cultural Anthropology* 33, no. 4 (2018): 570–595.

29
US Global Change Research Program, "Chapter 20: US Caribbean," *Fourth National Climate Assessment Report* (2018), https://nca2018.globalchange.gov/chapter/20/ .

30
Ibid.

31
Azad Henareh Khalyani, William A. Gould, Eric Harmsen, Adam Terando, Maya Quinones, and Jaime A. Collazo, "Climate Change Implications for Tropical Islands: Interpolating and Interpreting Statistically Downscaled GCM Projections for Management and Planning," *Journal of Applied Meteorology and Climatology* 58, no. 7 (2016): 265–282.

32
Lisa Nicole Jennings, Jamison Douglas, Emrys Treasure, and Grizelle González, "Climate change effects in El Yunque National Forest, Puerto Rico, and the Caribbean region" (United States Department of Agriculture and US Forest Service, General Technical Report, Southern Research Station, 2014), https://www.fs.usda.gov/treesearch/pubs/45918 .

33
US Global Change Research Program, "Chapter 20," https://nca2018.globalchange.gov/chapter/20/ .

34
Lijing Cheng, John Abraham, Zeke Hausfather, and Kevin E. Trenberth, "How fast are the oceans warming?," *Science* 363, no. 6423 (2019): 128–129.

35
Aurelio Mercado-Irizarry, "Sea Level Rise: A Projection," Report to the Puerto Rico Climate Change Council (March 2017).

36
Paula Ezcurra and Isabel C. Rivera-Collazo, "An assessment of the impacts of climate change on Puerto Rico's Cultural Heritage with a case study on sea-level rise," *Journal of Cultural Heritage* 32 (July–August, 2018): 198–209.

37
Rivera-Collazo, "Severe Weather and the Reliability of Desk-Based Vulnerability Assessments," 1–20.

38
On salinization in Puerto Rico, see Jaime A. Collazo, Adam J. Terando, Augustin C. Engman, Paul F. Fackler, and Thomas J. Kwak, "Towards a Resilience-Based Conservation Strategy for Wetlands in Puerto Rico: Meeting Challenges Posed by Environmental Change," *Wetlands* (2018). On the health effects of salinization see, Paolo Vineis, Queenie Chan, and Aneire Khan, "Climate change impacts on water salinity and health," *Journal of Epidemiology and Global Health* 1 (2011): 5–10.

39
Félix I. Aponte-Ortiz, "La problemática de los Acuíferos del Sur," *Claridad*, https://www.claridadpuertorico.com/la-problematica-de-los-acuiferos-del-sur/ .

40
Bill Weir, "20,000 pallets of bottled water left untouched in storm-ravaged Puerto Rico," *CNN*, September 20, 2018.

41
Hilda Lloréns, "The Race of Disaster: Black Communities and the Crisis in Puerto Rico," *Black Perspectives* , April 17, 2019, https://www.aaihs.org/the-race-of-disaster-black-communities-and-the-crisis-in-puerto-rico/ ; Carlos García Quijano, John J. Poggie, Ana Pitchon, and Miguel H. Del Pozo, "Coastal Resource Foraging, Life Satisfaction, and Well-Being in Southeastern Puerto Rico," *Journal of Anthropological Research* 71, no. 2 (Summer 2015): 145–167.

42
María Suárez Toro, "Mortal Embrace: Conflicting forces of nature, alongside the ecological intervention of traditional fishermen, helped mitigate the destruction wrought in Puerto Rico by Hurricane Maria," *Samudra* 78 (January 2018).

43
Alexa Dietrich, Adriana Garriga-López, and Claudia Garriga-López, "Hurricane Maria Exposes Puerto Rico's Stark Environmental and Health Inequalities" *Items* (Social Science Research Council, October 3, 2017), https://items.ssrc.org/just-environments/hurricane-maria-exposes-puerto-ricos-stark-environmental-and-health-inequalities/ .

44
Carmen H. Rodríguez, "El Sistema de agua potable de Puerto Rico vuelve a la normalidad con lentitud," *Kaiser Health News*, June 14, 2018.

45
Déborah Berman Santana, "Resisting toxic militarism: Vieques versus the U.S. Navy," *Social Justice* 29, no. 1 (2002), 37–47. See also, Carmen Concepción, "The Origins of Modern Environmental Activism in Puerto Rico in the 1960's," *International Journal of Urban and Regional Research* 19, no. 1 (1995): 112–128.

46
Zoë Schlanger, "Puerto Ricans desperate for water are drinking from Superfund sites," *Quartz*, October 12, 2017, https://qz.com/1101320/puerto-ricans-desperate-for-water-are-drinking-from-superfund-sites/ , and Timothy Gardner/Reuters, "As Puerto Rico Struggles With Lack of Drinking Water, Residents Turn to Toxic Waste Sites," *Time*, October 12, 2017, https://time.com/4979095/puerto-rico-drinking-water-waste-sites/ .

47
Ingrid Padilla, Celsys Irizarry, and Katherine Steele, "Historical Contamination of Groundwater Resources in the North Coast Karst Aquifers of Puerto Rico," *Revista Dimension* 3 (2011): 7–2. See also, John Hunter and Sonia I. Arbona, "Paradise Lost: An Introduction to the Geography of Water Pollution in Puerto Rico," *Social Science and Medicine* 40, no. 10 (1995): 1331–1355.

48
Omar Alfonso, "Arroyo Barril: Coal Ash and Death Remain 15 Years Later," *Centro de Periodismo Investigativo* , December 20 2018, http://periodismoinvestigativo.com/2018/12/arroyo-barril-coal-ash-and-death-remain-15-years-later/ .

49
Rick Karlin, "SUNY Chancellor Johnson resigns from AES Corp. Board," *Times Union*, March 7, 2019, https://www.timesunion.com/news/article/SUNY-Chancellor-Johnson-resigns-from-power-13671599.php/

50
Omar Alfonso, "Damage by coal ash to the southern aquifer cannot be undone," *La Perla del Sur* and *Centro de Periodismo Investigativo* , March 25, 2019, http://periodismoinvestigativo.com/2019/03/damage-by-coal-ash-to-the-southern-aquifer-cannot-be-undone/ .

51
Omar Alfonso, "Toxins from AES's ashes are contaminating groundwater in Puerto Rico," *La Perla del Sur* and *Centro de Periodismo Investigativo* , March 15, 2018, http://periodismoinvestigativo.com/2018/03/toxins-from-aess-ashes-are-contaminating-groundwater-in-puerto-rico/ .

52
"Puerto Ricans Block Waste Dump, Attacked by Police," *Telesur* , August 2, 2019.

53
CyberNews, "Denuncian supuesto intento del gobernador de tirar cenizas toxicas de carbón en todo Puerto Rico," *La Perla del Sur* , November 26 2018, https://web.archive.org/web/20210516035300/https://www.periodicolaperla.com/denuncian-supuesto-intento-del-gobernador-de-tirar-cenizas-toxicas-de-carbon-en-todo-puerto-rico/ .

54
Gavin Bade, "EPA moves to give states more leeway on coal ash," *Utility Dive* , March 2, 2018.

55
James Schultz, James P. Kossin, Marshall Shepherd, Justine Ransdell, Rory Walshe, Ilan Kelman, and Sandro Galea, "Risks, Health Consequences, and Response Challenges for Small-Island-Based Populations: Observations from the 2017 Atlantic Hurricane Season," *Disaster Medicine and Public Health Preparedness* 13, no. 1 (2018): 5–17.

56
John D. Sutter and Omaya Sosa Pascual, "Deaths from bacterial disease in Puerto Rico spiked after Maria," *CNN*, July 3 2018, https://helenair.com/lifestyles/health-med-fit/deaths-from-bacterial-disease-in-puerto-rico-spiked-after-maria/article_df1d84d6-f20b-536a-9630-89cb916c9798.html .

57
Omaya Sosa Pascual, "Puerto Rico tuvo un brote de leptospirosis tras el huracán María, pero el gobierno no lo dice," *Centro de Periodismo Investigativo* , July 3 2018, http://periodismoinvestigativo.com/2018/07/puerto-rico-tuvo-un-brote-de-leptospirosis-tras-el-huracan-maria-pero-el-gobierno-no-lo-dice/ .

58
Richard Porter, "After the Storm Comes the Rainbow: Love, Home, and Permaculture in Puerto Rico," *Voices of Reform* 1, no. 1 (2018): 106.

59
Eliván Martínez Mercado, "Puerto Rico Gives Away Over $519 Million to Multinational Seed Corporations Including Monsanto," *Center for Investigative Journalism* , July 13, 2016.

60
Zaire Dinzey-Flores, “The Development Paradox,” *NACLA Report on the Americas* 50, no. 2 (2018): 163–169. See also, Déborah Berman-Santana, “Geographers, Colonialism, and Development Strategies: The Case of Puerto Rico,” *Urban Geography* 17, no. 5 (1996): 456–474.

61
One frustrating case is that of the Salinas Aquifer Storage and Recovery Project, which was to be the first ever “hazard mitigation” project of the US Federal Emergency Management Agency (FEMA) in Puerto Rico. The project involved the construction of a canal between the Patillas Reservoir (which collects more ambient water than it can contain, draining sixty percent of the water it collects out to sea) and the nearby Salinas Reservoir (which suffers frequent water deficits). The project was funded in August of 2017, one month before Hurricane Maria. Yet nearly two years after Maria there is no public update, and FEMA not made any new information available on the agency’s website.

62
See https://www.facebook.com/WaterforPuertoRico/ .

63
Daniel Christian Wahl, *Designing Regenerative Cultures* (Axminster: Triarchy Press, 2016).

64
Ana Gabriela Serrano Ocasio, *El movimiento agroecológico como actor del desarrollo en Puerto Rico: un estudio sobre el rol de las cadenas productivas cortas en la promoción de la agroecología como modelo alternativo de desarrollo local* , (Georgetown University, 2018).