

# Drought in the U.S. Caribbean: Impacts on Crops



**Authors:** Eva Holupchinski, Nora Álvarez-Berrios, William Gould, and Josh Fain (USDA Caribbean Climate Hub, USFS)

**Graphic:** Integration & Application Network, University of Maryland Center for Environmental Science

Agricultural production in Puerto Rico and the U.S. Virgin Islands (USVI) is important for the region's economy, food security, and rural livelihoods. Farms in the region are mostly small-scale and cultivate a wide variety of crops including plantains, vegetables, coffee, hay, and ornamental plants. Small-scale farms of 10 acres or less are much more common in the U.S. Caribbean than in the continental U.S. While the variety of crops these farms provide is vital to the region, smaller financial margins can make them more vulnerable to climate-related hazards.

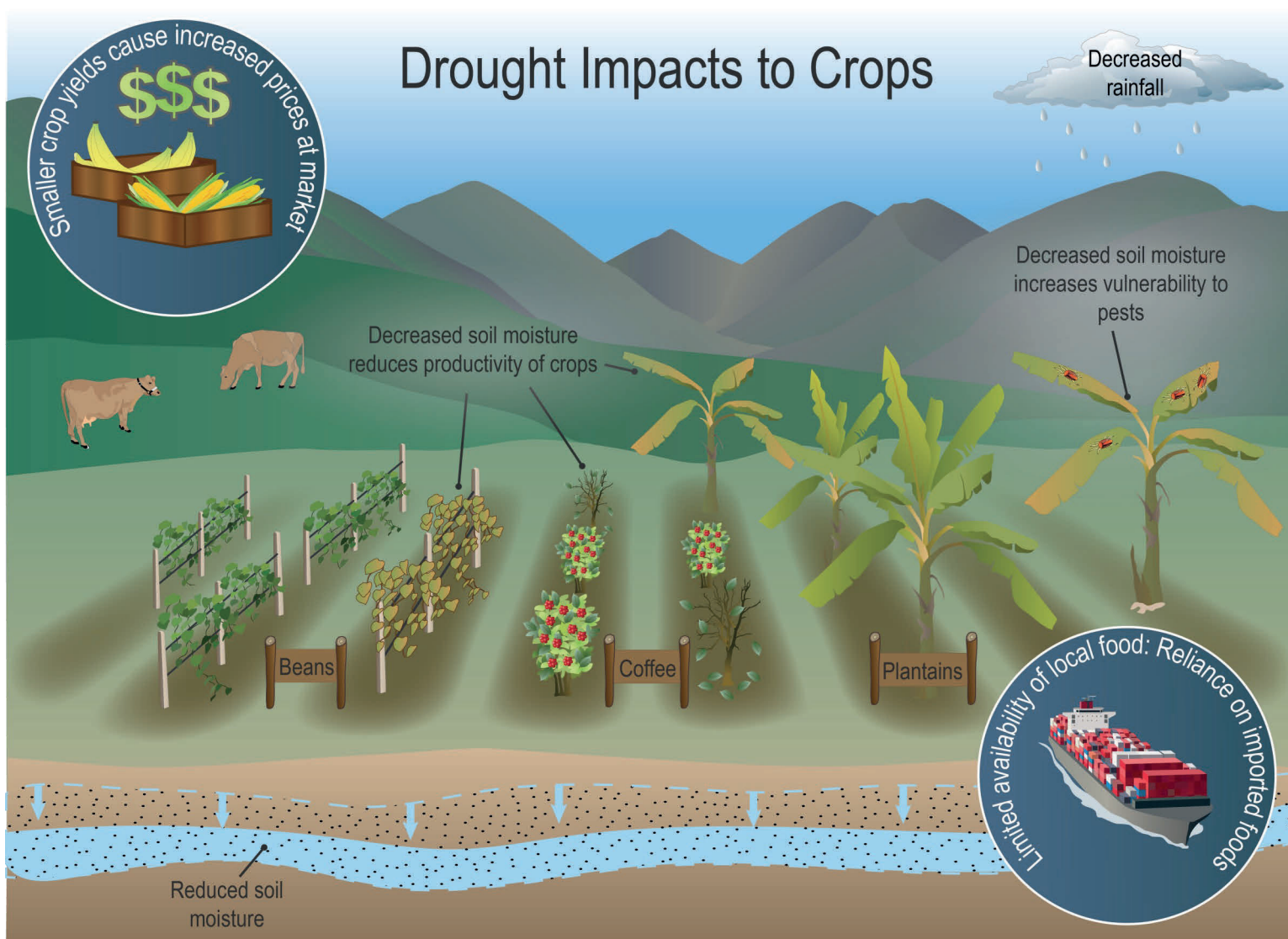
Of the many climate events that threaten agricultural production in the region, increasing drought is one of the most devastating. agricultural sector is typically the first to feel the impacts of drought, since the majority of crops in the U.S. Caribbean are rain-fed. Drought conditions can quickly lead to reduced crop yield, desiccation and crop losses island-wide. The As the climate changes, droughts in the U.S. Caribbean are projected to become more frequent and intense. Implementing the use of cover crops, water retention ponds, and drought tolerant varieties can help reduce the impacts of drought.

## About this Series

This fact sheet is part of a series examining what we know about the impacts of drought on ecosystems and agriculture in the U.S. Caribbean. Explore the other fact sheets on:

- Coastal Estuary Ecosystems
- Freshwater Ecosystems
- Tropical Forest Ecosystems
- Livestock

View the complete series here:  
[usgs.gov/casc/IslandDrought](https://usgs.gov/casc/IslandDrought)



## Short-Term Impacts

- **Produce Quality:** Drought can stunt growth, resulting in smaller, lower quality produce.
- **Higher Prices:** Lower yields and higher operating costs can mean higher prices for consumers.
- **Vulnerability to Pests:** As soil moisture decreases, crops dry out and become more vulnerable to insects.

## Long-Term Impacts

- **Local Food Availability:** As staple crops are impacted, there will be a reduction in the availability of local food. Imported food is often less fresh, with lower nutritional value.
- **Saltwater Intrusion:** Overuse of groundwater for irrigation could lead to more salt-water intrusion into aquifers.
- **Coffee Production:** Coffee production may be reduced due to less optimal conditions and an increase in pests.

## Spatial Impacts

Since 2000, all regions of Puerto Rico have been exposed to some level of drought conditions. The east and southeastern regions have experienced the most frequent droughts. In 2014, the coffee-growing industry was among the most impacted by drought. In the drought of 2015, the most heavily impacted crops in Puerto Rico were grass, fodder, and plantains, accounting for 85% of the \$14 million in agricultural losses caused by drought. In the USVI, the impacts of the 2015 drought were most notable in the eastern regions of St. John and St. Thomas and across the entire island of St. Croix.

## Cross-Sector Impacts

**Economic:** Drought conditions lead to increased expenses for farmers which results in elevated prices for local food and an increased reliance on imported food products.

**Water Supply:** Reduced freshwater availability can lead to conflicts between agricultural and other sectors.

## Current Activities & Future Research Directions

- The USDA Natural Resource Conservation Service (NRCS) - Caribbean Area is helping U.S. Caribbean producers in mitigating the effects of drought. Recommended practices include establishing cover crops for improved water infiltration, installing efficient irrigation systems for effective water resource use.
- The Scientific Drought Committee of Puerto Rico works to advise the local government on recommended strategies for water conservation as drought conditions progress.
- Further research on drought-tolerant crops will help local producers adapt to more frequent drought events and decreased rainfall. This research is underway, and two varieties of drought-tolerant common beans were recently developed at the USDA Agricultural Research Service Tropical Agricultural Research Center in Mayagüez, Puerto Rico.

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# Drought in the U.S. Caribbean: Impacts on Livestock



**Authors:** Eva Holupchinski, Nora Álvarez-Berrios, William Gould, and Josh Fain (USDA Caribbean Climate Hub, USFS)

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The production of dairy and beef is important for food security and the economies of the U.S. Caribbean. The dairy industry is the leading agricultural sector in Puerto Rico, contributing about 22% of the total agricultural income. Region-wide, beef and dairy production generate over 25,000 jobs and occupy more than 50,000 acres. In the U.S. Virgin Islands, cattle production has been declining in recent years due to higher insurance costs and natural disasters, while sheep and goat production has increased.

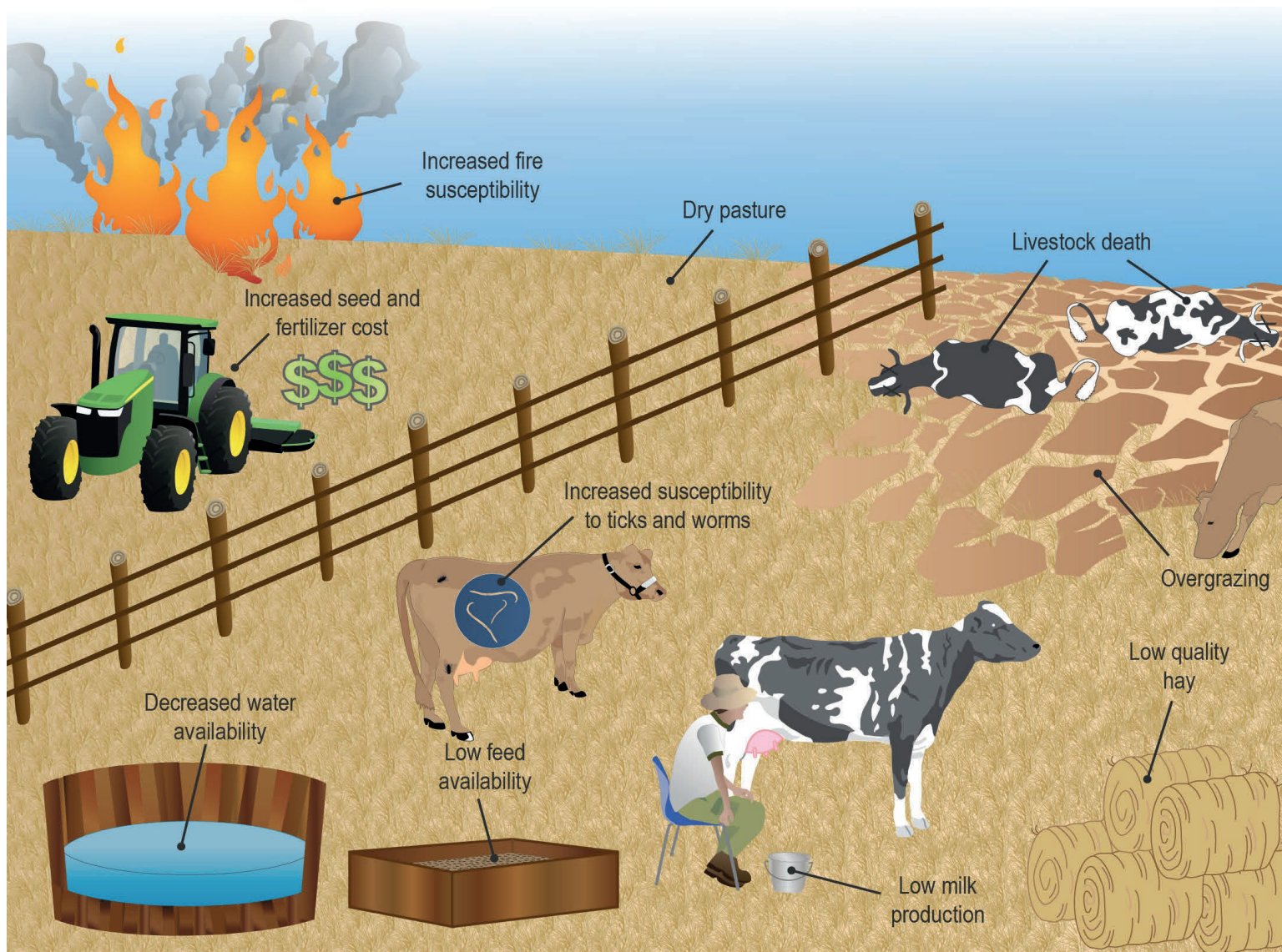
Caribbean countries are particularly vulnerable to climate change due to their geography and economic capacity. Climate change is driving temperatures higher and the region is experiencing more frequent and intense drought conditions. This affects livestock by decreasing water and feed availability, increasing susceptibility to worms and ticks, provoking heat stress, and reducing milk production.

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## Short-Term Impacts

- **Dry Pastures:** Dry pastures lead to lower quality hay and increased fire danger.
- **Decreased Production:** Heat stress can decrease milk production in dairy cattle and lower quality in beef.
- **Overgrazing:** Decreases in feed availability can lead to overgrazing.

## Long-Term Impacts

- **Reduced Range Quality:** Nutrient poor, drought-tolerant grass species may spread, decreasing range quality.
- **Increased Costs:** Production costs rise as farmers rely more heavily on imported feed and need to re-sow overgrazed pastures.
- **Hay Shortages:** Decreased water availability can lead to hay shortages.

## Spatial Impacts

In Puerto Rico, livestock and dairy production are most common in the municipalities of Hatillo, Yabucoa, Camuy, Arecibo, Naguabo, San Sebastián, Lajas, Humacao, and Isabela. In 2015, two of the most heavily drought-impacted crops in Puerto Rico were grass and fodder, both essential for livestock nutrition.

In the USVI, livestock production is most common on St. Croix. In the summer of 2015, intense heat and lack of rain dried up ponds and grasses, forcing producers to collect palm fronds and tree branches for fodder, depend on expensive imported feed, and cull herds.

## Cross-Sector Impacts

**Economic:** The impacts of drought on livestock can have consequences for the local economy. Lack of available feed during periods of drought forces livestock and dairy producers to purchase expensive concentrate feed, resulting in higher-priced meat and dairy products. Higher pricing makes it more difficult for local producers to compete with imported meat and dairy products.

**Environmental:** Drought-stricken rangelands are more prone to wildfire, soil compaction, increased water runoff which decreases groundwater recharge, and increased flooding during storms.

## Current Activities & Future Research Directions

- The USDA Natural Resource Conservation Service (NRCS) is helping producers in the region mitigate the effects of drought through the Environmental Quality Incentives Program (EQIP). NRCS recommended practices include proper irrigation management for efficient water use and higher yields, rotational grazing for pasture maintenance, and the establishment of water sources for livestock such as ponds, wells and springs. Heat stress can also be limited by adding shade to farms and selecting varieties of drought and heat-resistant pasture, forage, and livestock species such as star grass and the “bald” Puerto Rican cow (Slick-haired Holstein).
- Research is needed to identify strategies that optimize livestock productivity while using fewer resources. During periods of drought, increased efficiency in feeding and nutrition strategies can bolster dairy and beef production while generating less carbon dioxide and methane.

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# Drought in the U.S. Caribbean: Impacts on Coastal Estuary Ecosystems



**Authors:** Brent Murry, USFWS; Miguel Garcia-Bermudez, USFWS; Shelley Crausbay, Conservation Science Partners; Kate Malpeli, National CASC  
**Graphic:** Integration & Application Network, University of Maryland Center for Environmental Science

The topography of Puerto Rico and the U.S. Virgin Islands (USVI) is characterized by steep terrain and short distances to the sea. This means that freshwater runs off the islands quickly, coming into contact with seawater in coastal estuaries. The physical characteristics of estuaries change as the tides rise and fall, creating a wide range of habitats that support diverse plants and wildlife, including economically and culturally important native species such as cetí and land crabs, as well as game fishes such as snook and tarpon. These ecosystems are already heavily threatened by human activities such as urbanization, increased sedimentation, and pollution. Changing climate conditions, such as more frequent and severe drought, pose an additional stressor. Because rivers in Puerto Rico and temporary streams (known locally as “ghuts”) in the USVI feed the coastal estuaries of the U.S. Caribbean, changes to streamflow can impact estuaries and the wildlife they support. For example, during prolonged periods of low flow, withdrawals from the Espiritu Santo River, which feeds into the Espiritu Santo estuary in northeast Puerto Rico, can reach 100% of instream flow and the river can run dry. This reduction in the amount of freshwater entering the estuary can increase salinity levels, altering habitat conditions and leading to declines in the richness and abundance of freshwater species.

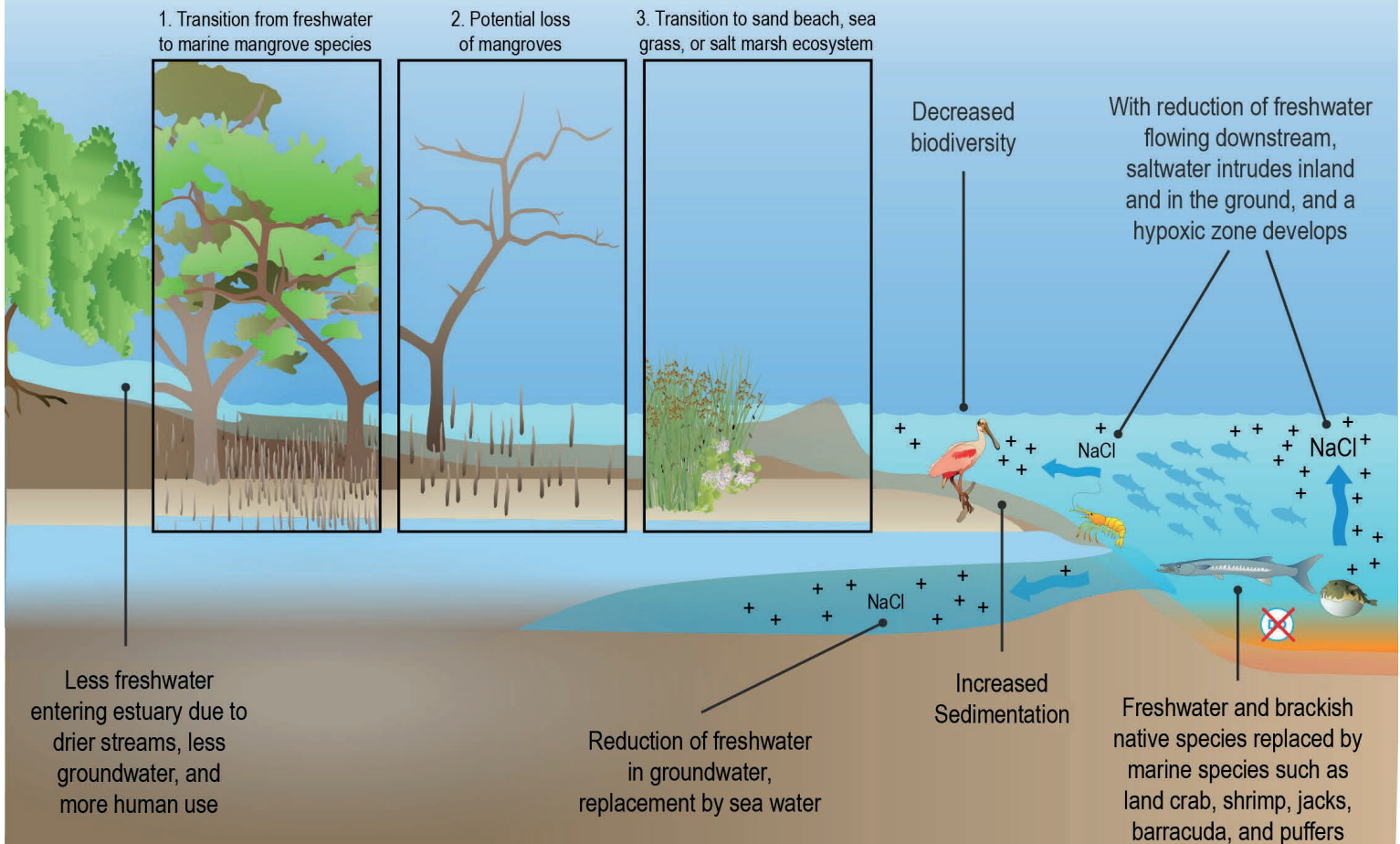
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## Drought can change estuarine landscapes in three ways:



## Short-Term Impacts

- **Wetland Function:** Salt-tolerant species will become dominant, changing the ways in which wetlands function. However, it's possible that certain ecosystem services may be preserved. Mangroves are salt tolerant, however the degree of tolerance varies among species. Black mangroves are very sensitive to changes in hydrology, and both drought and flooding can cause mortality.

## Long-Term Impacts

- **Habitats:** Mangroves could be converted to salt marsh or mud flats, affecting habitat quality for fish and birds.
- **Species Assemblages:** Freshwater and brackish estuaries support important native species (e.g. cetí and land crabs) and game fish such as snook and tarpon. These systems could change to dominance by marine species such as jacks, barracuda, and puffers.

## Spatial Context

Drought can impact the amount of freshwater that enters estuaries, altering their composition. The amount of saltwater in estuaries is already increasing due to sea-level rise. This saltwater meets freshwater that has its origins in both surface water (e.g. rivers, streams, and overland flows) and groundwater. Decreases in rainfall result in decreased freshwater entering estuaries due to (1) reduced surface flows; (2) reduced aquifer recharge and groundwater flows; and (3) increased human withdrawals, which further drive reductions in surface and groundwater flows. Changes in the distribution and concentration of saltwater can have both short- and long-term impacts on mangroves and other keystone wetlands plant species, with subsequent impacts to the numerous ecosystem services they provide.

## Cross-Sector Impacts

Hotter 21st century drought conditions coincide with a reduction in the amount of freshwater available to coastal estuaries because of an overall negative trend in rainfall and increasing water demand for people. Meanwhile, coastal estuaries are increasingly sensitive to drought because of land use change, fragmented forests, and disconnected rivers that exacerbate drought conditions. Ultimately, drought conditions - including human water use during drought - may lead to broad-scale changes in the plant and animal communities in coastal estuaries that in turn cascade to human communities through altered recreation, fishing, and other ecosystem services.

## Future Research Directions

### Key Questions & Needs

- How will drought impacts to coastal estuaries differ across Puerto Rico's precipitation gradient?
- Long-term monitoring of estuaries
- Improved understanding of the dynamics between human water use and demand of surface and groundwater interacting with sea-level rise (increasing inshore and underground intrusion of saltwater) and the implications of short- and long-term drought on the salinity gradient and subsequent predictions of wetland habitat changes.
- How does aging infrastructure (e.g. dams in the coastal and lowland areas) influence the fresh- and saltwater balance in coastal and lowland rivers and wetlands?

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# Drought in the U.S. Caribbean: Impacts on Freshwater Ecosystems



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**Graphic:** Integration & Application Network, University of Maryland Center for Environmental Science

Healthy and functioning freshwater ecosystems are needed for successful conservation and management of native fish and invertebrate species, and the services they provide to communities across the U.S. Caribbean. Yet streams, rivers, and reservoirs are vulnerable to the effects of extreme weather, urbanization, energy development, and other environmental and human-caused disturbances. One major management concern is the impact of prolonged drought on freshwater ecosystems. Drought impacts streamflow, dissolved oxygen content, water quality, stream connectivity, habitat availability, and other characteristics necessary for sustaining fish and invertebrates. These changes can impact species interactions, abundance, life history events, and presence of native and non-native species.

The U.S. Virgin Islands (USVI) are particularly sensitive to drought, because almost all streams are ephemeral and typically only flow after rainfall. These intermittent channels, known locally as “ghuts”, run down the surface of steep slopes, rather than through the ground, and are important sources of freshwater. Natural springs are often located in ghuts, and can form pools that serve as habitat for wetland and migratory birds, freshwater shrimp and fish, and amphibians.

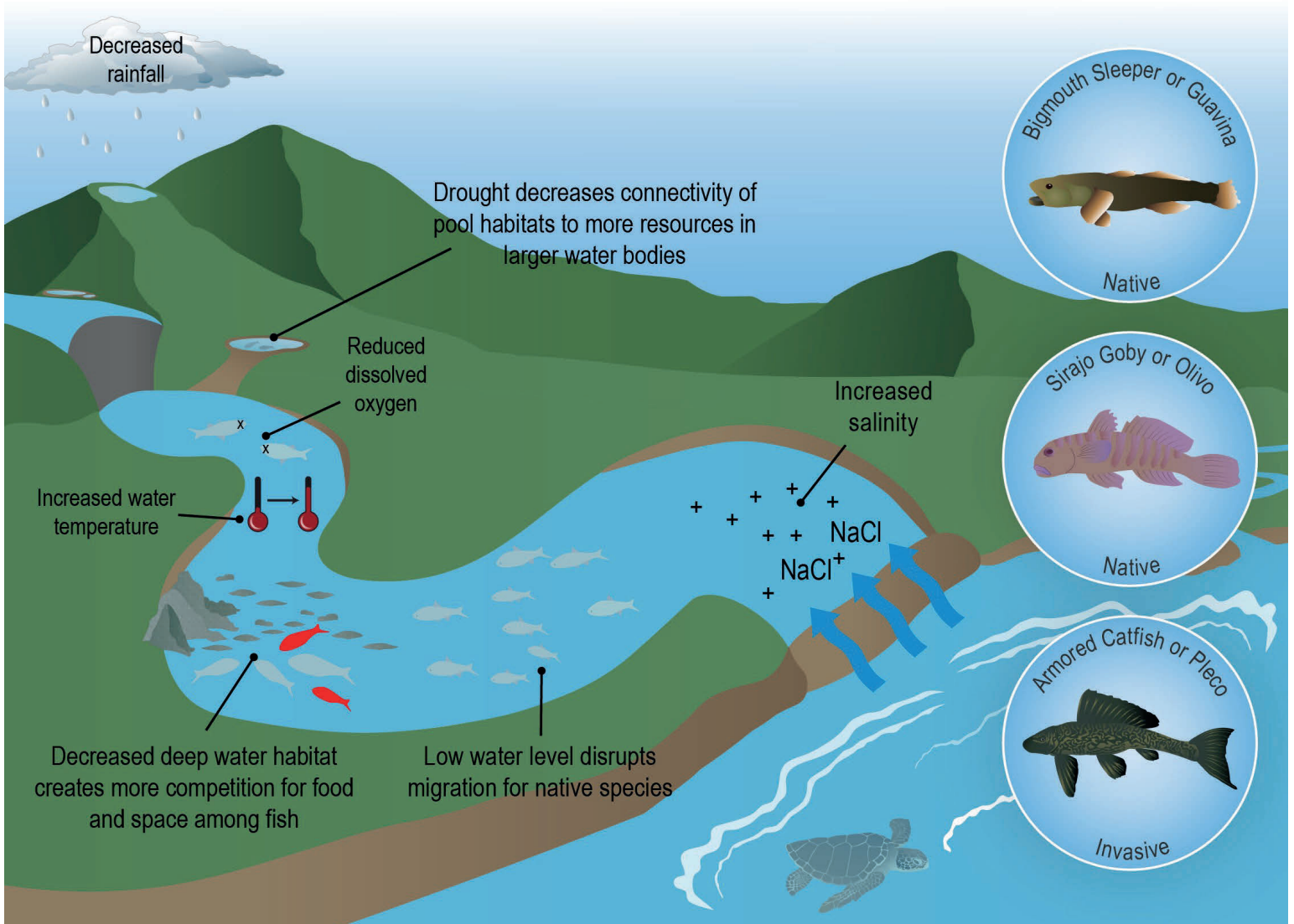
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## Short-Term Impacts

- **Altered Flows:** Drought can reduce stream flow, which can impact important pool habitat and dissolved oxygen concentrations, leading to changes in fish and invertebrate growth and survival.
- **Invasion of Introduced Species:** Reduced discharge and frequency of floods can facilitate the invasion of introduced fish species (such as the armored catfish or pleco), creating more competition for native fish.

## Long-Term Impacts

- **Changes in Fish Assemblages:** Increases in non-native species, shifts in the presence of native fish and invertebrates, and permanent loss of endemic native species can occur.
- **Loss of Habitat:** Drought can lead to restrictions on upstream migrations of fish and invertebrates, impacting their ability to carry out important life events.

## Spatial Impacts

Reductions in stream flow will impact freshwater ecosystems island-wide. However, the severity of drought can vary across an island. During the 2015 drought, the eastern half of Puerto Rico, which normally receives more rainfall than the western half, was under severe drought conditions, while the drier, western half was under moderate drought or abnormally dry conditions.

The 2015 drought resulted in a documented shift of native fish species to non-native species in an eastern Puerto Rican stream, likely due to a decrease in discharge and reduction of flood events. This suggests that freshwater ecosystems that experience a shift in flooding frequency and decreased discharge may be the hardest hit as droughts become more frequent and severe with climate change.

## Cross-Sector Impacts

Drought impacts on freshwater ecosystems can affect water supply for human consumption, fish and invertebrate populations, and agricultural practices. Negative impacts on freshwater ecosystems, including reduction in water filtration capacity, quality, and frequency of flood events can occur and will alter important habitat for fish and invertebrate species. Changes in freshwater organisms assemblages can then reduce the beneficial services these ecosystems provide to the public. In addition, public recreational use of aquatic resources could be affected by drought events, with socioeconomic and cultural impacts.

## Current Activities & Future Research Directions

### Current Research Activities:

- Development of a long-term fisheries dataset from the Rio Piedras ecosystem in Puerto Rico (NC State University, University of Puerto Rico).
- Researching ecosystem integrity in riparian waterways and microclimate monitoring in the USVI (Water Resources Research Institute).

### Key Research Needs:

- Long-term monitoring in Puerto Rico and the USVI to enable the identification of ecological changes following drought.
- Improved understanding of the mechanisms behind drought impacts on aquatic species interactions and life histories.

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