

# Drought in the U.S. Affiliated Pacific Islands: Impacts to Ecosystems



By: Susan Cordell (USFS), Abby Frazier (East-West Center), Clay Trauernicht (UH Cooperative Extension), and Yin-Phan Tsang (UH Mānoa)

Drought has variable impacts on ecosystems in each of the 6 jurisdictions of the United States Affiliated Pacific Islands (USAPI). Available information on drought impacts to ecosystems varies by jurisdiction, but in general, few studies have addressed the impacts of drought on ecosystems. The available information highlights that the main impact of drought on ecosystems in the USAPI is the increased intensity of wildfires. Ecosystems in the USAPI are not adapted to wildfires, especially in jurisdictions such as Pohnpei and Kosrae, where, historically, fire has not been a stressor on ecosystems. In particular, increased wildfires from drought are important for high islands in the USAPI, and especially for Guam. The relationship between drought and wildfire is also affected by El Niño-Southern Oscillation (ENSO) cycles. The most devastating combination is when you have a wet year with excessive fuel buildups, followed immediately by a dry El Niño year. The initial ignitions of wildfires are almost always human-induced; however, drought conditions affect the intensity and duration of the wildfire events that impact ecosystems in the USAPI.

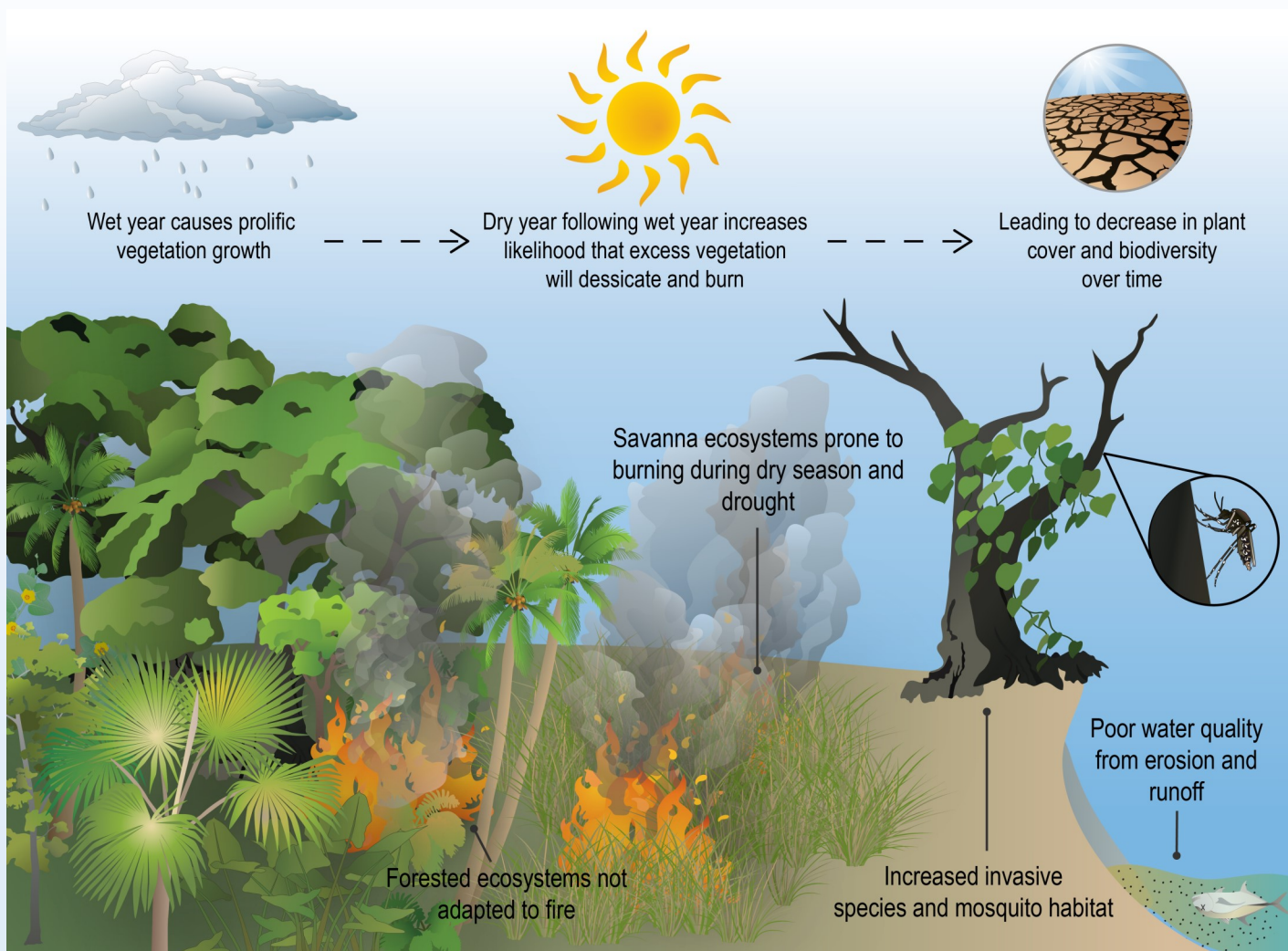


Diagram produced by the Integration and Application Network, University of Maryland Center for Environmental Science ([ian.umces.edu](http://ian.umces.edu)).

# Drought Effects on Ecosystems in the USAPI

Drought has both direct and indirect effects on terrestrial and aquatic ecosystems of the Pacific islands with varying impacts per jurisdiction (Polhemus, 2017). Drought-related stress can directly increase mortality of plants and animals, or make them more vulnerable to predation and disease (Trauernicht et al., 2015). Indirect impacts on native ecosystems have manifested through drought-induced land use change and loss of habitats. For example, Pohnpei saw rapid increases in watershed deforestation following 1997-98 El Niño as lowland crop losses led farmers to shift in sakau (kava) cultivation to upland areas (Merlin and Raynor, 2005). The prolonged drought decreased the availability of habitats for freshwater species and the connectivity between streams and estuaries for migratory species. However, our understanding of the impact on the species of these ecosystems due to the loss of habitats is limited due to the lack of studies.

Wildfires in the Pacific region are often devastating. Despite the fact that fires are almost entirely a result of human-caused ignitions, drought has increased fire extent and intensity. The western islands, including Palau, Yap, and the Marianas, where grassland ecosystems can comprise 10-20% of island land cover, often have pronounced annual dry seasons which already create conditions for fire in the absence of ecological drought. However, El Niño events can greatly exacerbate drought and create conditions for large fires even on the wetter islands to the east. For example, an estimated 25% of Pohnpei and 10% of Guam burned during the El Niños of 1982-83 and 1997-98, respectively (van der Brug 1986). Drought and fire are also connected to reef health and game management. Invasive ungulates (e.g., goats) worsen post-fire erosion and transport of sediment down to coastal areas, which damages coral reef ecosystems.

## SHORT & LONG-TERM IMPACTS

- Drought-induced wildfires reduce forest area, impacting species inhabiting these areas
- Areas affected by drought-induced wildfire are also susceptible to invasion of non-native animals or plants, which provide more fuel for the spread of wildfires
- Wildfire and non-native ungulates increase erosion, which impacts near-shore ecosystems such as coral reefs
- Reduced carbon cycling resulting from a decrease in forest productivity
- Increased likelihood of forest pests and pathogens
- Longer recovery time of aquifers following marine over-wash events
- Ecosystems in Guam are particularly impacted by the effects of wildfire and drought dynamics

## Cross-Sector and other Impacts

The impacts of drought on ecosystems have consequences for water supply and downstream marine habitats:

- **Freshwater Supply and Delivery:** Drought lengthens the recovery from marine over-wash events, which are expected to increase in frequency. This salt water inundation degrades infrastructure, freshwater supplies, agriculture, and habitats for threatened and endangered species. Extended drought often ties in with El Niño events in Pacific region, which lessens the groundwater recharge, lowers the groundwater table, and changes freshwater delivery to many unique ecosystems. One of those is the mangrove estuaries, which provides valuable habitats as rear ground for fishes (Drexler and Ewel, 2001). Another is the nearshore lakes, which support unique jellyfish species (Dawson et al., 2001; Polhemus, 2017)
- **Marine ecosystems:** Rain after extended drought and wildfire increases erosion and sediment delivery to nearshore environments negatively impacting coral reefs.

**References:** Dawson, Mike N; Martin, Laura E; Lolita K, Lolita K.; Penland. 2001. Jellyfish swarms, tourists, and the Christ-child. *Hydrobiologia*. Springer Netherlands. 451: 131-144; Drexler, J. Z., & Ewel, K. C. 2001. Effect of the 1997-1998 ENSO-related drought on hydrology and salinity in a Micronesian wetland complex. *Estuaries*, 24(3): 347-356; Merlin, M. and Raynor, W., 2005. Kava cultivation, native species conservation, and integrated watershed resource management on Pohnpei Island. *Pacific Science*, 59(2): 241-260; Polhemus, Dan. A. 2017. Drought in the U.S.- Affiliated Pacific Islands: A multi-level assessment. <https://doi.org/10.21429/C9ZS74>; Trauernicht, C., E. Pickett, C. P. Giardina, C. M. Litton, S. Cordell and A. Beavers. 2015. The contemporary scale and context of wildfire in Hawaii. *Pacific Science* 69 (4): 427-444; van der Brug. 1986. The 1983 drought in the western Pacific. US Geological Survey Open-File Report 85-418.

Funding provided by the USGS National Climate Adaptation Science Center with in-kind support from Pacific Island Climate Science Center, IAN, and United States Forest Service.

Citation for this report: Cordell, S., A. Frazier, C. Trauernicht, Y-P. Tsang. 2019. Drought in the U.S Affiliated Pacific Islands: Impacts to Ecosystems. Workshop Report. 2p. <https://www.sciencebase.gov/catalog/item/Scdd565be4b0292737463434>.