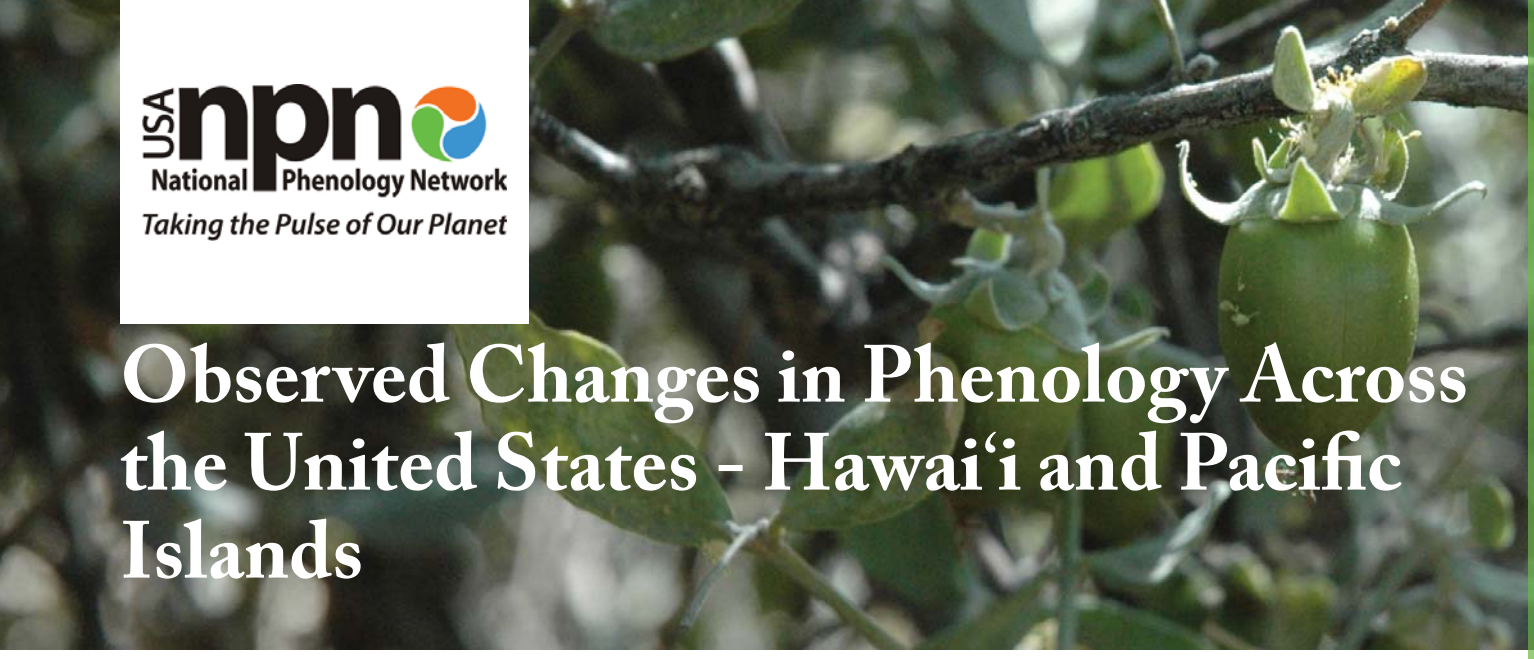
USA npn National Phenology Network
Taking the Pulse of Our Planet



Observed Changes in Phenology Across the United States - Hawai'i and Pacific Islands

Background

Phenology — the seasonal timing of life cycle events in plants and animals such as flowering, hibernation, and migration — has been linked to shifts in the timing of allergy seasons, public visitation to National Parks, and cultural festivals. Change in phenology, recognized as a bio-indicator of climate change impacts, has also been linked to increased wildfire activity and pest outbreak, shifts in species distributions, spread of invasive species, and changes in carbon cycling in forests. Phenological information can and already is being used to identify species vulnerable to climate change, to generate computer models of carbon sequestration, to manage invasive species, to forecast seasonal allergens, and to track disease vectors, such as mosquitoes and ticks, in human population centers.

"Plant phenology in Hawai'i and other tropical islands may be linked more directly to rainfall regimes along elevation gradients than average air temperatures."

This is one in a series of eight, geographic region-focused information sheets that summarizes documented changes in plant and animal phenology over the past century across the United States. This summary is based on long-term studies (10 years or more) published in the primary scientific literature since 2001. A forthcoming manuscript synthesizes the findings of the eight regional information sheets.

This information was developed in support of the U.S. Global Change Research Program's **National Climate Assessment,** and can be used to facilitate preparation for the cascading effects of ongoing climate change.

Hawai'i and the Pacific Islands

The Hawaiian and Pacific Islands contain both tropical moist and tropical dry forests. Islands, because of their isolation, are especially vulnerable to ecosystem changes, particularly because these systems have many endemic species [1, 2]. The Hawaiian Islands have been affected by invasive species and substantial native species loss. Changes in sea level, increasing ocean temperatures and extreme weather events, such as typhoons, also can greatly affect these systems [1, 2]. In the Pacific, air and sea temperatures are expected to increase in the next century and there is a projected increase in heavy rainfall events [1, 2]. Elevation and temperature can also interact, with intra-island temperatures projected to increase more at higher elevations than at lower elevations [3]. High-elevation habitats are often refugia for endemic species on these islands, and they are likely to be affected by ongoing changes in climate in these regions [3].

Changes in Phenology - A Need for Information

Collecting phenological data – first steps

There is a scarcity of long-term phenological data and how it relates to climate for Hawai'i and the Pacific Islands. While there is research on phenology in other tropical regions, the biogeography of Hawai'i and the Pacific Islands is different from continental tropical regions, and caution should be taken when extrapolating results. The research that has been conducted to date (see included case study) indicates the timing and amount of precipitation influence phenology in this tropical system more than temperature. In addition, elevation and the interaction of elevation with precipitation, are important influences on phenology of tropical species. In a study that begins to detail protocols for collection of phenological data in Hawai'i, plots were established across both an elevation and east-west gradient on the island of Maui. Preliminary results suggest that differences in vegetation composition are related to moisture

availability [4]. Vegetation composition and weather data in these plots will be monitored so that changes in phenology and what drives these changes can be observed.

Case Study: Responses of Hawaiian Forests to Drought

Researchers examined the responses of Hawaiian rainforests and dry forests to both seasonal and El Niño responses to drought. They examined Normalized Difference Vegetation Index (NDVI) and cloud cover using satellite data for 2000-2009. During dry years, vegetation of the dry forests responded with 'brown-down', while rainforests 'greened up.' In these dry years, there was less cloud cover in the rainforests, which resulted in NDVI exhibiting increased greenness in rainforests due to increased light availability. Thus, leaf phenology of dry forests was more closely linked to precipitation while phenology in rainforests was more related to light availability. This study illustrates that in the tropics, phenology is often linked more to moisture availability than temperature and that different ecosystems may respond very differently to changing precipitation patterns. With projected changes in precipitation patterns in this region, changes in tropical forest phenology are likely [5].

References

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PREPARED BY:

Stacey A. Leicht -Young, Patuxent Wildlife Research Center, U.S. Geological Survey

Carolyn A.F. Enquist, USA National Phenology Network & The Wildlife Society

Jake F. Weltzin, USA National Phenology Network & U.S. Geological Survey

CONTACT:

Carolyn A.F. Enquist, Science Coordinator

USA National Phenology Network & The Wildlife Society

1955 East 6th Street, Tucson, AZ 85721

E-mail: carolyn@usanpn.org

Phone: 520-792-0571

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