

# Phenology Monitoring On Refuges: Midway Atoll National Wildlife Refuge

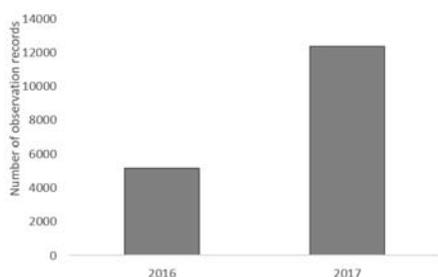
## The USA-NPN/Refuge Partnership: A commitment to science-based management

Best management practices and refuge goals are driven by science; a thorough understanding of the biological, as well as ecological, needs of natural resources is key to effective resource management. One component of this understanding is phenology, the study of naturally occurring lifecycle events. If land managers are interested in removing invasive plants before they begin to reproduce, phenology can be used to find the best time to increase removal efforts. If naturalists are interested in knowing when particular bird species will be present in a region, phenology can help them plan their visit accordingly.

The US Fish & Wildlife Service's National Wildlife Refuge System is partnering with the USA National Phenology Network (USA-NPN) to document changes in phenology across the Refuge System. Refuges utilize the USA-NPN's scientifically-vetted, species-specific monitoring protocols, data management infrastructure, and data visualization tools to make comparisons in plant and animal phenology across refuges and surrounding areas. Since 2009, refuge staff and citizen scientist volunteers have collected over 170,000 observations on focal plants and animals at 22 refuges.

## Nature's Notebook at Midway Atoll National Wildlife Refuge

In 2016, Midway Atoll National Wildlife Refuge began a phenology monitoring project using the USA-NPN's plant and animal observation program, *Nature's Notebook* to document the timing



"It has been a great project for us, and we appreciate the structure that the *Nature's Notebook* system provides!" – Ann Humphrey, US Fish & Wildlife Service

"We are interested in doing more phenology monitoring in the future, which might include more invasive plants and possibly also to guide native plant restoration efforts (e.g., informing seed collection)" – Rob Taylor, National Wildlife Refuge Association

between leaf out and seed development of invasive *Verbesina encelioides*, or golden crownbeard. *Verbesina* is fast-growing and forms dense, monotypic stands, and used to cover 70% of the land surface across both Eastern and Sand Islands at Midway. This species disrupts and degrades surface-nesting seabird habitat, and is linked to lower reproductive success and survival of albatross.

Starting in 2011, the USFWS obtained a one million dollar grant from the National Fish and Wildlife Foundation to begin concentrated control efforts with herbicide, which resulted in a decrease of *Verbesina* cover to 1% of the land surface by 2015. Phenology monitoring efforts aid a more focused, surgical approach to eliminate the remaining patches of *Verbesina*, keeping the Refuge on

track to visit and treat all of the sectors across the Refuge to work toward full eradication. Two staff and one project collaborator began using *Nature's Notebook* for phenology observations of *Verbesina* at four different sites in the summer of 2016.

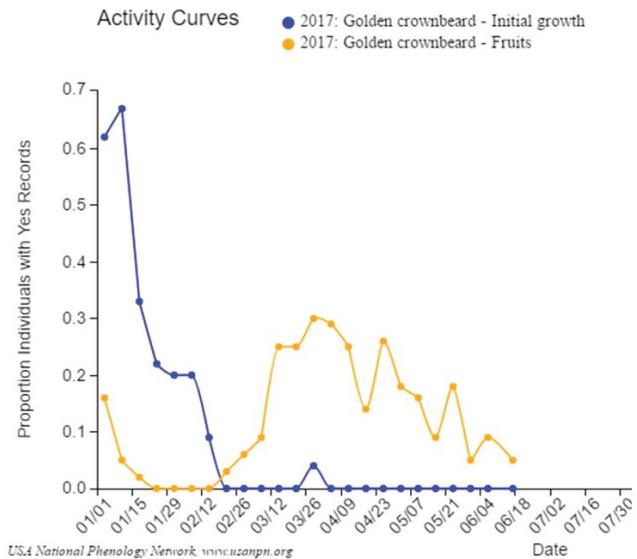
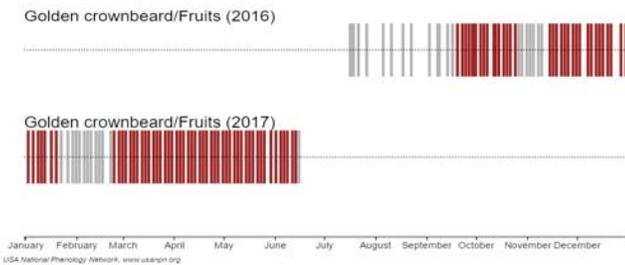
### Learning the optimal time to treat invasive species on a vulnerable island ecosystem

In 2016, Ann Humphrey, FWS Biological Technician, and Rob Taylor of the National Wildlife Refuge Association began an effort to learn more about the best time to treat invasive *Verbesina encelioides* at Midway. Kupu Americorps intern Wieteke Holthuijzen led the implementation of the program and the first year of monitoring.

The *Verbesina* plants monitored since August of 2016 have generated sufficient data to estimate the number of days required for this invasive plant to reach seed maturity (see table). The time it takes for *Verbesina* to reach seed maturity can vary threefold within a year, from 31 days in summer to 89 in winter.

Number of Days from 'Leaves' to 'Recent fruit or seed drop' for <i>Verbesina encelioides</i>			
	Minimum number of days	Maximum number of days	Range of days
August to October	31	53	22
December to April	89	110	21

The phenology calendar below displays the timing of *Verbesina* fruiting at Midway observation sites. Colored lines represent a day when a "yes" was reported. Gray bars represent when a phenophase was looked for but not observed. The calendar shows that there are multiple fruiting periods recorded for this species in all seasons observed so far.



The graph above shows the proportion of individual plants where initial growth of leaves and fruits were recorded. There is a peak in the number of individual plants with initial growth in mid-January. The peak in the number of individual plants with fruits is at the end of March. Knowing the amount of time in between initial growth and recent seed drop helps managers know how much time they have to get out to pull or treat this invasive species before it goes to seed.

This information is being used to guide weed treatment on the refuge. Specifically, the minimum number of days it takes for the plant to reach seed maturity is being used as the maximum time between visits to sites by the weed control technicians. Preliminary data collected in the last 12 months confirm that *Verbesina* plants grow and flower at different rates across the year, and there is no season when they are completely dormant. Staff will continue monitoring throughout the year so that control schedules can be adjusted accordingly.

Understanding how climate and phenology are interacting across the U.S. and around refuges is vital to natural resource management. *Nature's Notebook* provides an opportunity for refuges to involve staff and volunteers in science, as well as provides a framework to answer questions about climate impacts. With continued observations, *Nature's Notebook* can be implemented as a tool for community engagement and for tracking large-scale ecological changes, one observation at a time.

**USA npn**  
National Phenology Network

With major operational funding from:



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