

Pheno Forecasts predict seasonal activity of pest and invasive species to support decision making

The USA-NPN produces and distributes daily national maps – or Pheno Forecasts – indicating the status of insect pest and invasive plant life cycle stages as part of a growing suite of phenology map products.

The USA National Phenology Network's (USA-NPN) Pheno Forecast maps indicate the status of insect pest or invasive plant life cycle stages in real time across the contiguous United States¹. This information can guide when to monitor or undertake management activities. These maps, available at 2.5 km spatial resolution, are updated daily and are available six days into the future.



Pheno Forecast maps are offered for the following species:

Insect pests:

- apple maggot (*Rhagoletis pomonella*)
- Asian longhorned beetle (*Anoplophora glabripennis*)
- bagworm (*Thyridopteryx ephameraeformis*)
- bronze birch borer (*Agilus anxius*)
- eastern tent caterpillar (*Malacosoma americanum*)
- emerald ash borer (*Agilus planipennis*)
- spongy moth (*Lymantria dispar*)
- hemlock woolly adelgid (*Adelges tsugae*)
- lilac borer (*Podosesia syringae*)
- magnolia scale (*Neolecanium cornuparvum*)
- pine needle scale (*Chionaspis pinifoliae*)
- winter moth (*Operophtera brumata*)

Invasive plants:

- buffelgrass (*Pennisetum ciliare*)

ACCESS THE MAPS

Pheno Forecast maps are available on the USA-NPN website (www.usanpn.org/data/forecasts) and through the USA-NPN visualization tool (data.usanpn.org/npn-viz-tool/).

Pheno Forecasts are based on published growing degree day (GDD) or seasonal precipitation thresholds for life cycle events when monitoring and management actions are typically undertaken². Using the USA-NPN daily accumulated growing degree day maps³ or precipitation accumulations, locations are shaded as not yet approaching the life stage of interest, approaching the stage, experiencing the stage, and past the stage relative to an established threshold.

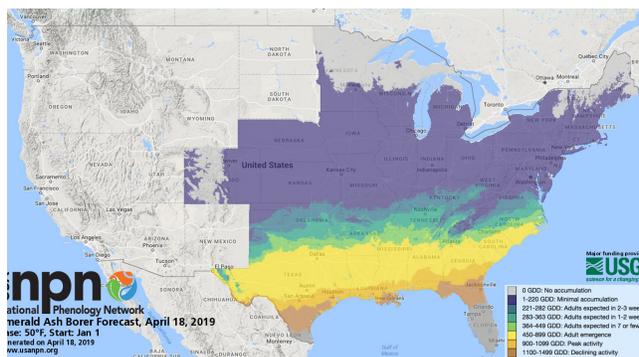


Figure 1. Emerald ash borer Pheno Forecast, April 18, 2019. Colors indicate the status of adult emergence. Dark purple indicates not yet approaching adult emergence, dark blue-green: adults expected to emerge in 2-3 weeks, dark green: adults expected to emerge in 1-2 weeks, light green: adults expected to emerge in 7 or fewer days, yellow: adults emerging, gold: peak adult emergence, brown: declining adult emergence, and dark gray: adult emergence past.

These maps are intended to provide a broad-scale prediction of when monitoring and management may be necessary and are intended to supplement local knowledge. Forecast accuracy may vary locally based on microclimatic variation. In addition, thresholds may perform with variable accuracy across species ranges. For more information about these pests and others specific to your state, contact your local Cooperative Extension program.

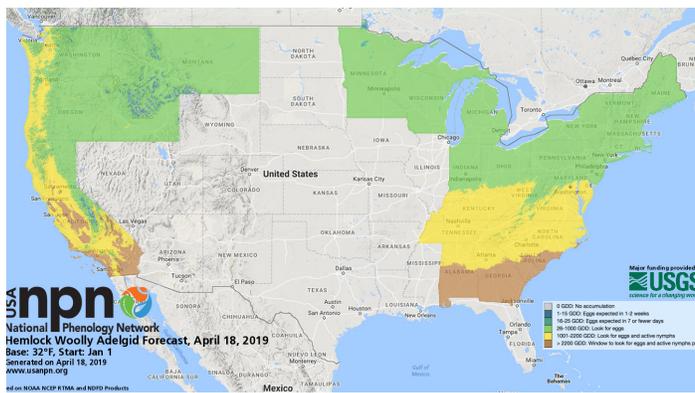


Figure 2. Hemlock woolly adelgid Pheno Forecast, April 18, 2019. Colors indicate the status of eggs and active nymphs. Dark dark blue-green indicates eggs expected to emerge in 1-2 weeks, dark green: eggs expected in seven or fewer days, light green: eggs present, yellow: eggs and active nymphs present, and brown: eggs and active nymphs passed.



Figure 3. Asian longhorned beetle Pheno Forecast, April 18, 2019. Colors indicate the status of adult emergence. Dark purple indicates not yet approaching adult emergence, dark blue-green: adults expected to emerge in 1-2 weeks, dark green: adults expected to emerge in seven or fewer days, light green: adults expected to emerge in 1-2 weeks, yellow: adults emerging.

Accessing the Pheno Forecasts through the USA-NPN visualization tool offers additional information on site-specific patterns of heat accumulation. This information can be used to evaluate whether insect pests will reach life cycle stages occur earlier or later than usual at a site.

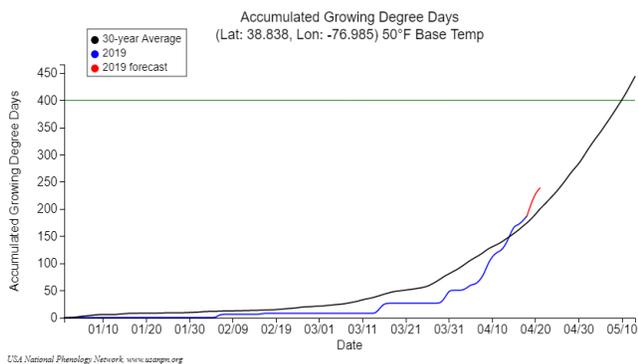


Figure 4 Growing degree day accumulation from April 18, 2019 for Washington, D.C. Clicking on a location on the map yields a plot of heat accumulation since Jan 1 (in blue) with the six-day forecast (in red) relative to average patterns of heat accumulation (in black).

RECEIVE UPDATES ON PEST ACTIVITY AT YOUR LOCATION

Sign up to receive advance warning by email of activity in your pest of interest 2 weeks, and 6 days, before the predicted life cycle stage is reached at your location. Sign up to receive notifications for any of the Pheno Forecasts at www.usanpn.org/data/forecasts.

The USA National Phenology Network is a national-scale monitoring and research initiative focused on collecting, organizing and delivering phenological data, information and forecasts to support natural resource management and decision-making, to advance the scientific field of phenology, and to promote understanding of phenology by a wide range of audiences.

REPORT PEST ACTIVITY AT YOUR SITE OVER THE SEASON

Tracking phenology at your site can help you choose the best time to perform management activities and identify pest or invasive species concerns early. Report the status of the Pheno Forecast species through the citizen science program, *Nature's Notebook*, and the USA-NPN's Pest Patrol campaign (www.usanpn.org/nn/PestPatrol).

Reporting can be done by anyone – professionals or volunteers – and raises awareness about particularly troublesome pests. These observations will be used to validate and improve the Pheno Forecast maps.

Learn more at www.naturesnotebook.org.



COMPLIANCE WITH FEDERAL POLICY
This info sheet has been peer reviewed and approved for publication consistent with USGS Fundamental Science Practices (pubs.usgs.gov/circ/1367)

REFERENCES:
1 Crimmins, TM, et al. Short-term forecasts of pest insect activity inform management activities. *Annals of the Entomological Society of America*. In review.
2 Crimmins, TM, et al. (2017) USA National Phenology Network gridded products documentation. U.S. Geological Survey Open-File Report 2017-1003. DOI: 10.3133/ofr20171003.
3 USA National Phenology Network. Daily accumulated growing degree day and Spring Index maps. Info sheet. www.usanpn.org/files/reports/USA-NPN_AGDD-and-SiX.pdf

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Front top photo of hemlock woolly adelgid: Connecticut Agricultural Experiment Station, Connecticut Agricultural Experiment Station, Bugwood.org; photo cropped
Front photo of emerald ash borer: David Cappaert, Bugwood.org