



How phenology has changed

Nature's Notebook video series





Photo: Tom Hennell via Unsplash, Public Domain



Photo: Johannes Plenio via Unsplash, Public Domain



Photo: Rasa Kasparaviciene via Unsplash, Public Domain

Photo: Georg Dionysius Ehret
via Wikipedia, Public Domain





Photo: Brian F Powell

Tulip tree

Liriodendron tulipifera

In New York, flowers 27 days
earlier than 200 years ago



Photo: Andrew Eroh via Unsplash, Public Domain

Source: Battle et al. 2022, *Journal of Ecology*

Horse chestnut
Aesculus hippocastanum
In Switzerland, leaf-out 11 days
earlier than 200 years ago

Photo: Henry Schneider via Unsplash, Public Domain
Source: Vitasse et al. 2022 *Nature Climate Change*

Horse chestnut
Aesculus hippocastanum
In Switzerland, leaf-out 11 days
earlier than 200 years ago

Photo: Jevgenijs Grigorjevs via Unsplash, Public Domain
Source: Vitasse et al. 2022 *Nature Climate Change*



Photo: Echo Surina

Common lilac
Syringa vulgaris
In New York, flowers 10 days
earlier than 200 years ago

Photo: Karo K. via Unsplash, Public Domain
Source: Battle et al. 2022, *Journal of Ecology*



Yellow trout lily
Erythronium americanum
In New York, flowers one
week earlier than 200
years ago

Photo: Patti Black via Unsplash, PUblic Domain
Source: Battle et al 2022, *Journal of Ecology*

A close-up photograph of a black cherry tree branch with several small, white, five-petaled flowers. The flowers have prominent yellow stamens and are arranged in a loose cluster. The background is a soft, out-of-focus green, suggesting foliage.

Black cherry tree

Prunus serotina

In New York, flowers three
days earlier than 200 years
ago

Photo: Ellen G Denny, CC BY-NC-SA 4.0

Source: Battle et al. 2022, *Journal of Ecology*

A close-up photograph of smooth sumac (*Rhus glabra*) flowers. The flowers are small, greenish-yellow, and arranged in dense clusters. A small, light-colored caterpillar with dark spots is visible on the left side of the image, crawling on the flowers.

Smooth sumac
Rhus glabra
In North Dakota, flowers
ten days later than 100
years ago

Photo: Dulcey Lima, The Morton Arboretum, CC BY-NC-SA 4.0
Source: Calinger and Curtis 2023, *PLOS One*



Photo: Tijan Manandhar via Unsplash, Public Domain

Henry David Thoreau



Photos: (left) Benjamin D. Maxham via Wikipedia, Public Domain;
(background) Erin E Posthumus, CC BY-NC-SA 4.0

A close-up photograph of St. John's wort (Hypericum perforatum) flowers. The flowers are bright yellow with numerous stamens, and the leaves are green and lanceolate. The background is a soft-focus field of similar flowers.

St. John's wort
Hypericum perforatum
In Massachusetts, not
keeping pace with changing
temperatures

Photo: Ronin via Unsplash, Public Domain

Source: Willis et al. 2008, *PNAS*



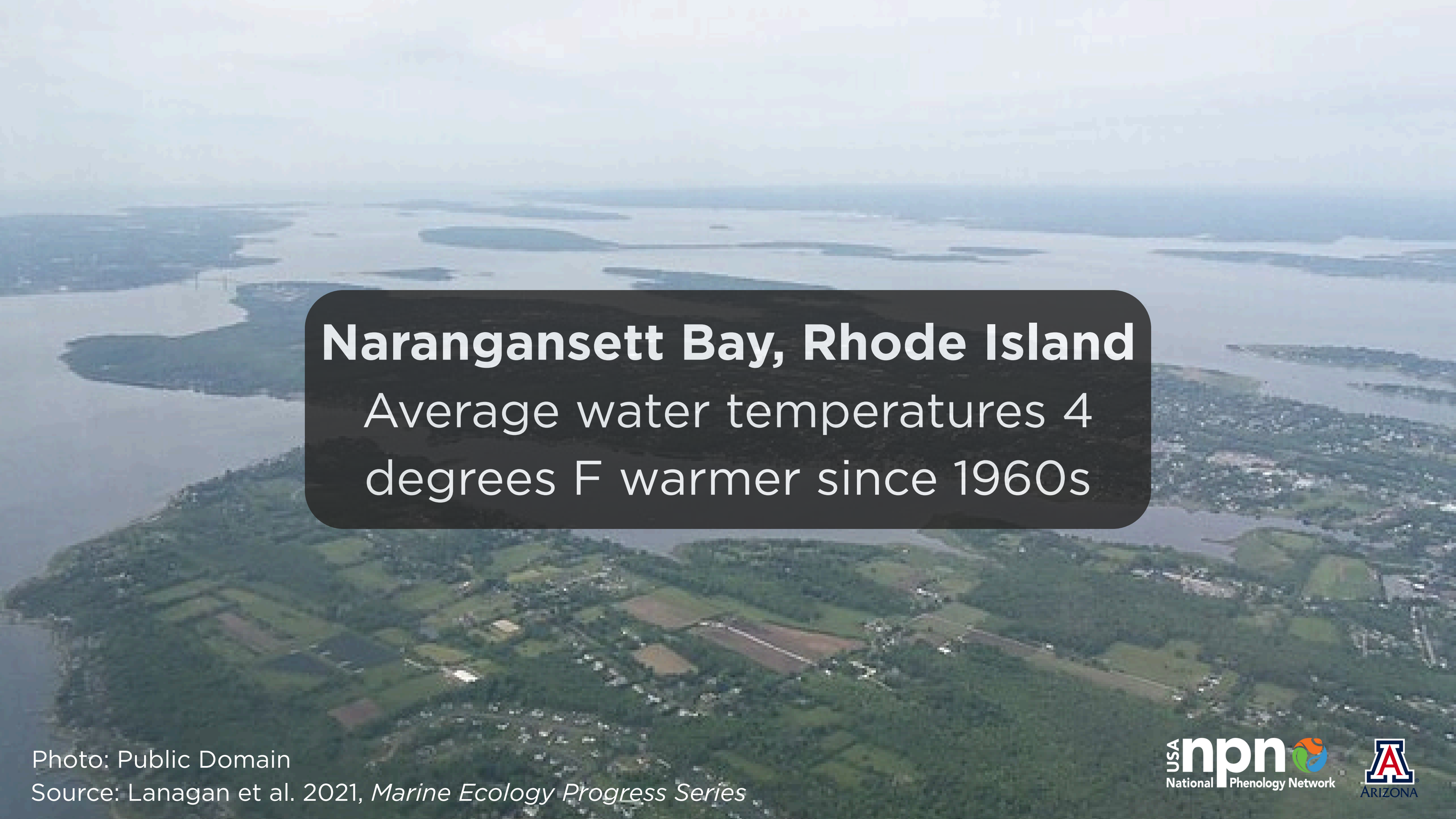
Photo: Silas Baisch via Unsplash, Public Domain



Photo: Brandon via Unsplash, Public Domain
Source: Lanagan et al. 2021, *Marine Ecology Progress Series*



Photo: Wolfgang Hasselmann via Unsplash, Public Domain
Source: Lanagan et al. 2021, *Marine Ecology Progress Series*



Narangansett Bay, Rhode Island

Average water temperatures 4
degrees F warmer since 1960s

Photo: Public Domain

Source: Lanagan et al. 2021, *Marine Ecology Progress Series*

Longhorn sculpin

Myoxocephalus

octodecemspinosus

Shorter wintertime stay by
118 days since the 1950s

Photo: Smithsonian Institute

Source: Lanagan et al. 2021, *Marine Ecology Progress Series*

Striped bass

Morone saxatilis

Summertime resident,
Staying 2 months longer



Photo: The New York Public Library via Unsplash, Public Domain

Source: Lanagan et al. 2021, *Marine Ecology Progress Series*



Photo: Gary Bendig via Unsplash, Public Domain





Photo: Brian F Powell

**Thank you for
your efforts!**

Photo: Brian F. Powell





Learn more at

usanpn.org



Photo: Brian F Powell

References (in order cited)

Battle, KF, Duhon A, Vispo CR, et al. 2022. Citizen science across two centuries reveals phenological change among plant species and functional groups in the Northeastern US. *Journal of Ecology* doi.org/10.1111/1365-2745.13926

Vitasse Y, Baumgarten F, Zohner CM, et al. 2022. The Great Acceleration of Plant Phenological Shifts. *Nature Climate Change* 12(4):300–302. doi.org/10.1038/s41558-022-01283-y

Calinger K and Curtis P. 2023. A Century of Climate Warming Results in Growing Season Extension: Delayed Autumn Leaf Phenology in North Central North America. *PLOS One* 18(3): e0282635. doi.org/10.1371/journal.pone.0282635

Willis CG, Ruhfel B, Primack RB, et al. 2008. Phylogenetic Patterns of Species Loss in Thoreau's Woods Are Driven by Climate Change. *Proceedings of the National Academy of Sciences* 105(44): 17029–17033. doi.org/10.1073/pnas.0806446105

Lanagan JA, Puggioni G, Oviatt CA, et al. 2021. Climate alters the migration phenology of coastal marine species. *Marine Ecology Progress Series*. doi.org/10.3354/meps13612

This video was created September 2025