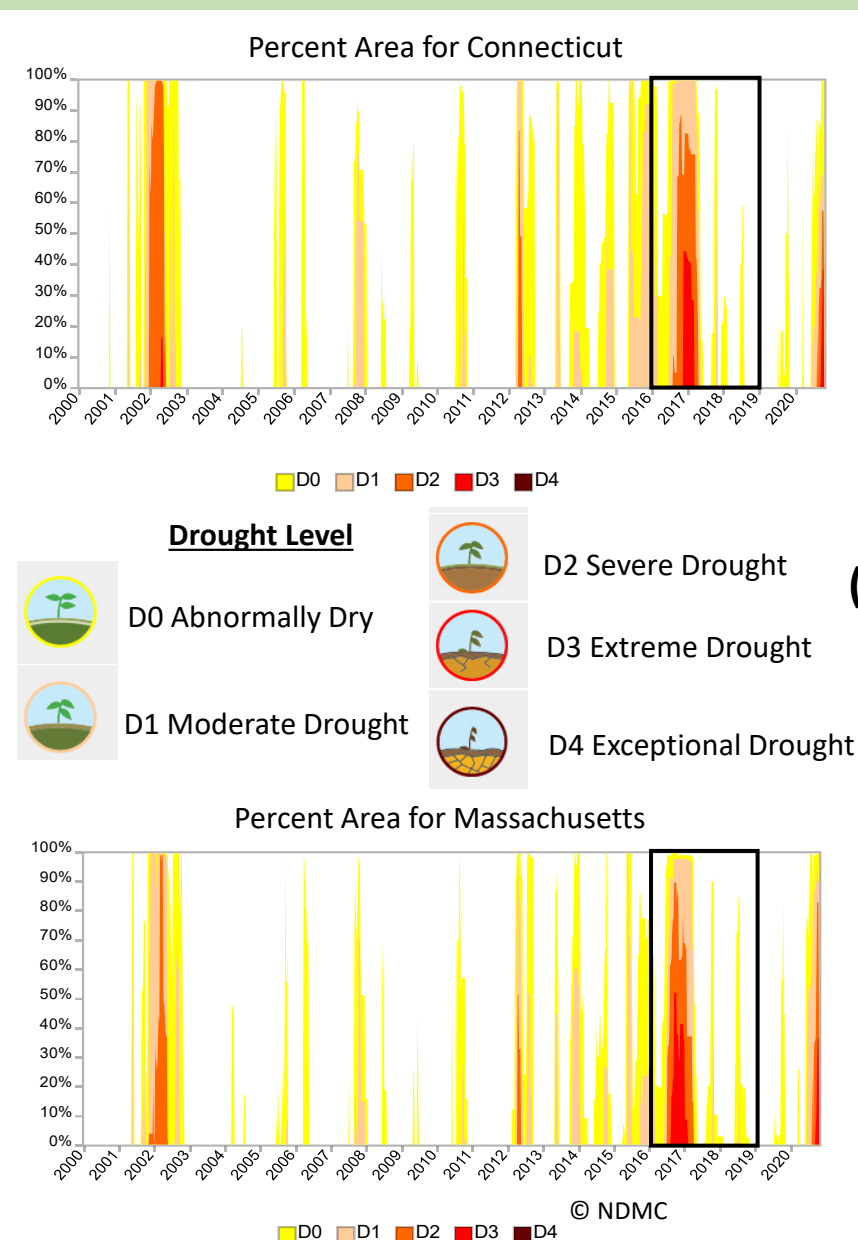


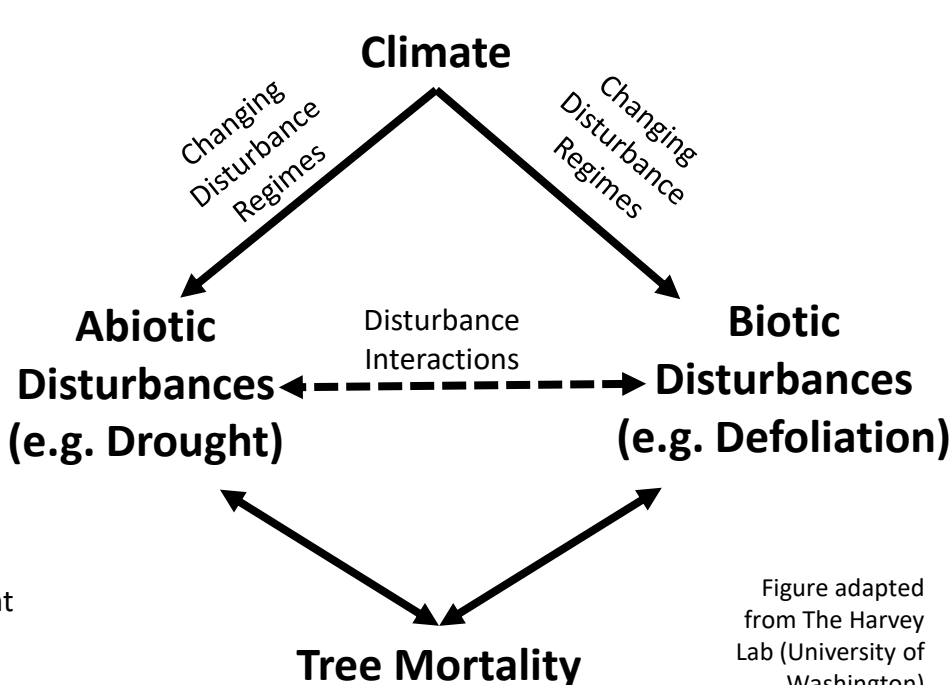
Assessing temporal dynamics of disturbance interactions as a driver of a novel forest mortality event

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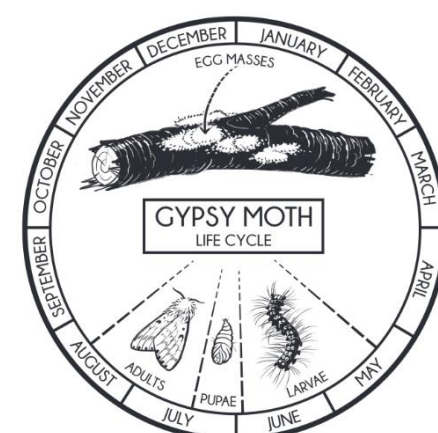


Background



Gypsy moth (*Lymantria dispar*) caterpillars defoliate trees in spring and early summer in southern New England. Significantly affected trees may put out new leaves (*refoliate*) or die.

Figure adapted from The Harvey Lab (University of Washington)



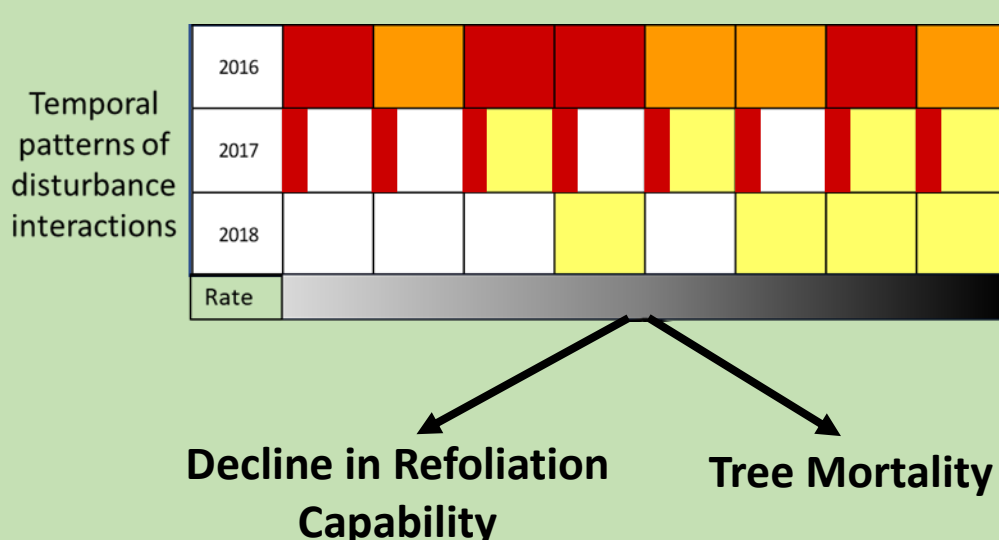
Disturbance interactions may have **compounding effects**, where the results are more severe than the results of the individual disturbances combined.

Research Questions

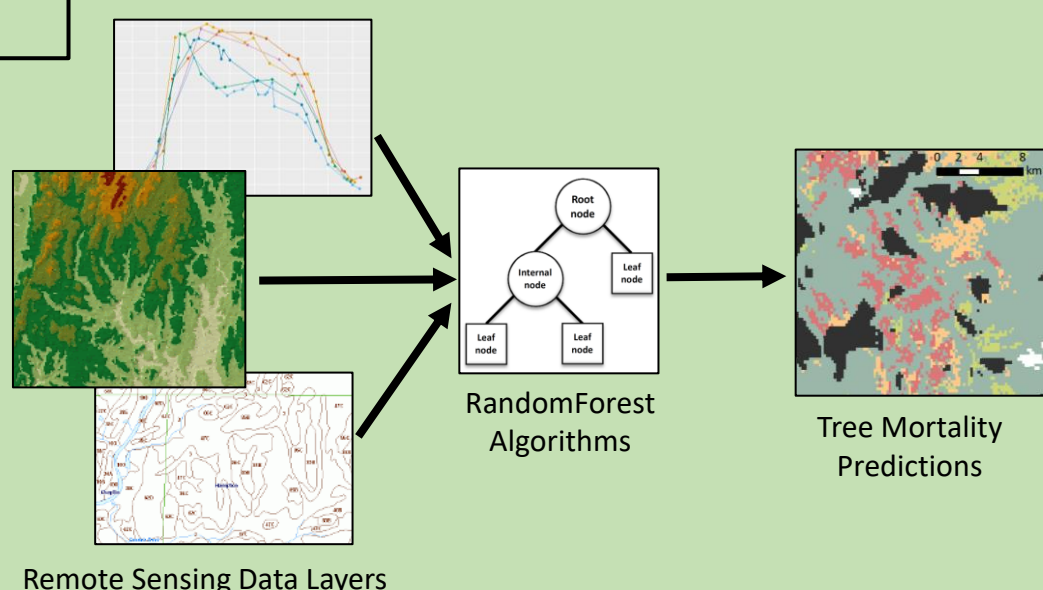
How do temporal patterns of gypsy moth defoliation in relation to drought influence rates of refoliation and tree mortality?

How accurately can tree mortality outcomes from interacting disturbances with different temporal patterns be predicted with remotely sensing data?

Hypotheses



Repeated defoliation and greater temporal proximity of defoliation onset to drought will decrease rates of refoliation and increase rates of tree mortality.



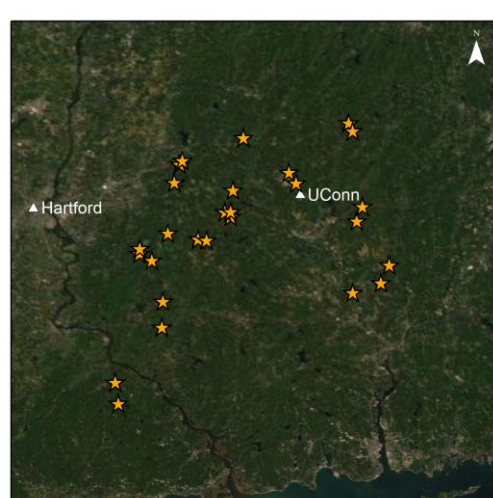
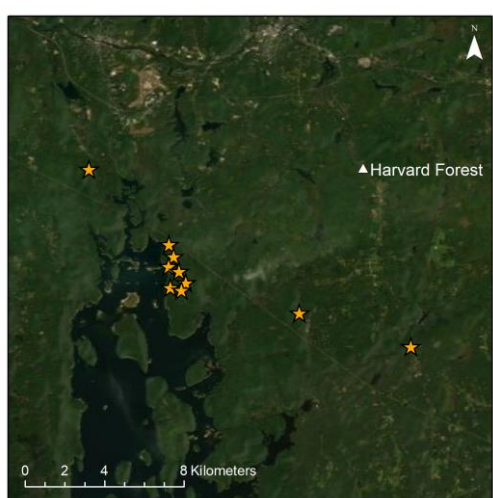
Algorithms using remotely sensed data will be able to accurately predict tree mortality levels but will not be as accurate field-based methods.

Field Data Collection

There are 37 field sites across CT and MA. Each site includes three 20m x 20m plots.

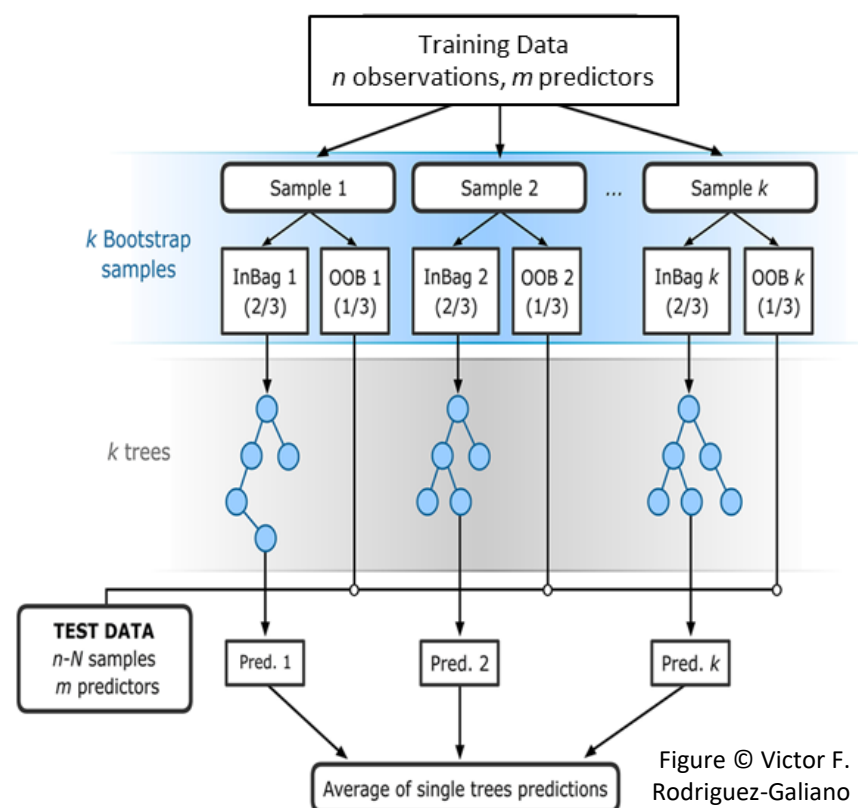
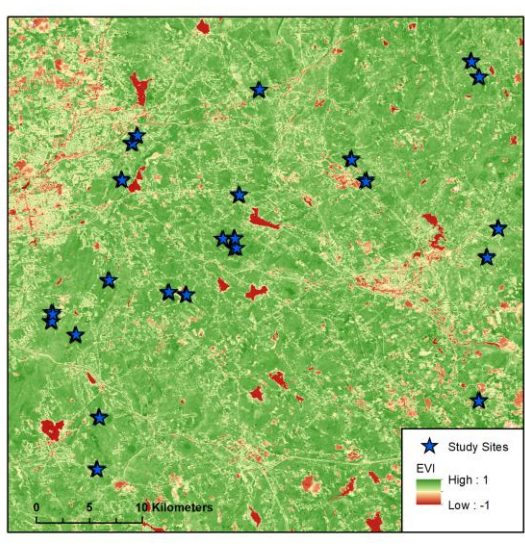
In 2019, all canopy trees (DBH > 20cm) were surveyed for species, size, canopy crown class, branch dieback, and mortality.

In 2017/2018, all CT sites were surveyed for gypsy moth egg masses and caterpillars. In 2018, all MA sites were surveyed for gypsy moth egg masses.



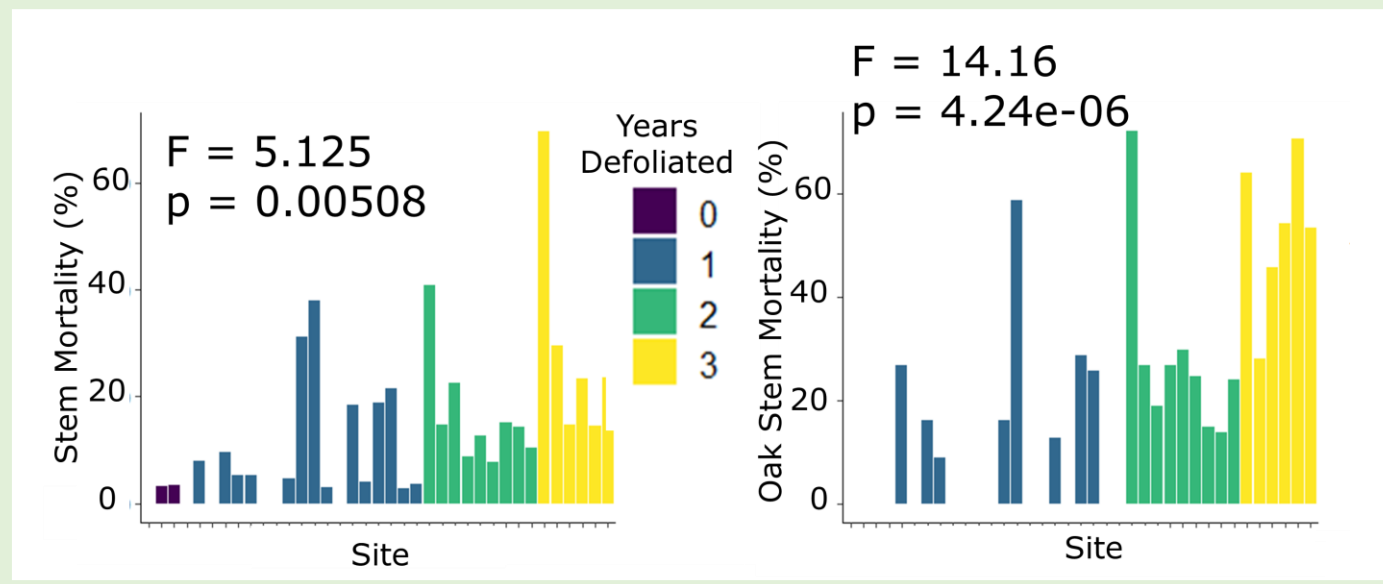
Methods

NASA's Harmonized Landsat-Sentinel (HLS) dataset was used to assess changes in vegetation greenness (NDVI, EVI) and moisture (NDMI) attributed to defoliation and refoliation.



RandomForest algorithms will be assessed for their ability to predict tree mortality outcomes using NDVI, EVI, and NDMI time series data.

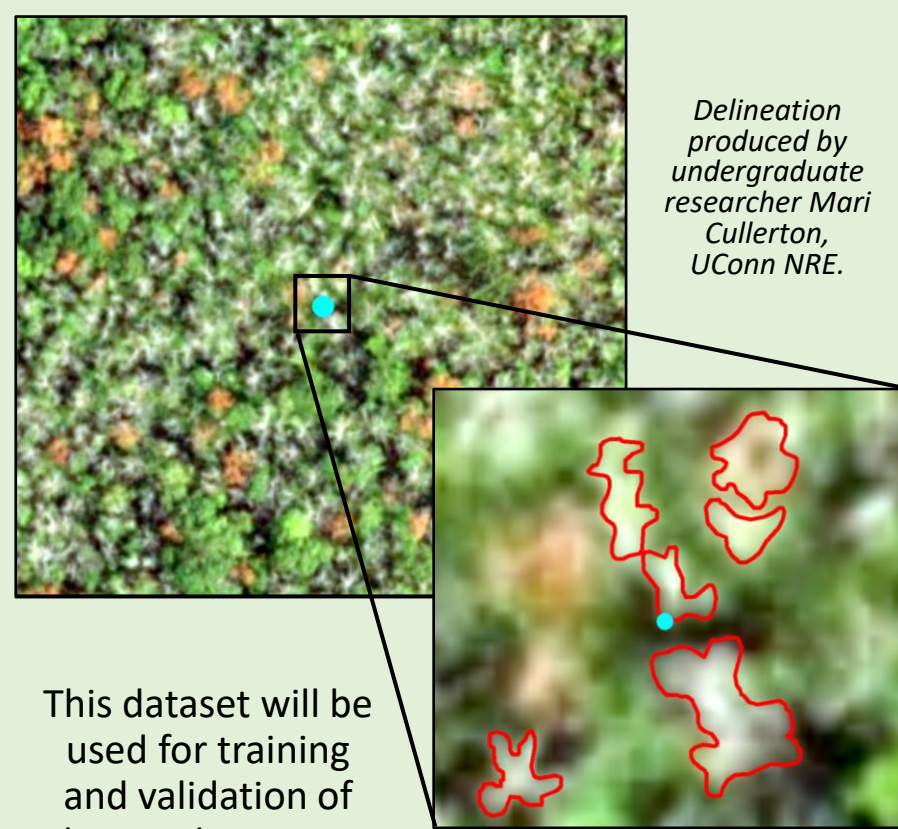
Preliminary Results



Preliminary statistics based on field data show that sites experiencing additional years of defoliation have higher rates of tree mortality using both overall and oak-specific* stem mortality rates.

*In southern New England, oaks are preferred host species of gypsy moth.

Beaver Brook Site, Plot 6: Tree Mortality Delineated from NAIP



This dataset will be used for training and validation of the RandomForest algorithm tests.

Background imagery is NAIP 2018. Red outlines represent dead tree crowns. Blue dot represents the plot center.

Preliminary Results

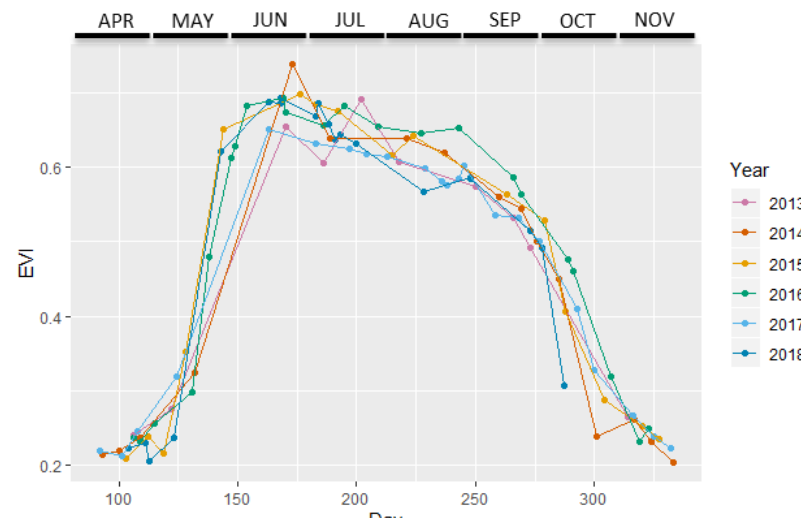
Examples of change in enhanced vegetation greenness (EVI) at two different sites. Sharp declines in EVI between June-July may be attributed to defoliation.

Pre-Disturbance Years: 2013-2015
Potential Disturbance Years: 2016-2018

Beaver Brook Site shows signs of defoliation in 2016, 2017 and possibly 2018.

Nathan Hale Site does not show signs of significant defoliation.

Nathan Hale Site, Plot 5



Tree Count	Total Mortality (Stem Count)	Total Mortality (%)
11	1	9.09%

Oak Count	Oak Mortality (Stem Count)	Oak Mortality (%)
7	1	14.29%

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