Temporal changes of oak species in the eastern United States

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Abstract: Oaks (*Quercus* spp.) are important tree species in the eastern United States. In recent decades, oaks have experienced a decline in abundance due to a combination of factors such as changes in fire regimes, climate change, and the spread of invasive species. Loss of oak populations can be detrimental because they provide important ecosystem services. Currently, it is not well understood how individual species have changed in recent years. This study used data from the Forest Inventory and Analysis (FIA) National Program to examine the dynamics of nine oak species. Changes of abundance in each diameter class were analyzed by comparing inventory data collected in the 1980s and in 2011 for each state. In general, a decline in smaller DBH (diameter at breast height) classes (approximately <38cm) and an increase in large DBH classes (approximately > 48cm) were observed for all nine oak species across the study area. The largest DBH classes had the greatest relative changes in states located at the edge of their ranges. The results confirmed that oak species are having difficulty regenerating because the abundance of smaller DBH classes is declining. As older trees die off there will not be enough younger trees to replace them. Attention is needed to ensure adequate recruitment of small size oaks to the large size overstory.

Introduction:

Currently in the United States some oak species are experiencing large scale decline. Many studies examining this topic concentrate on a limited spatial scale or limited number of species. Our analysis provides a regional and comprehensive understanding by examining multiple oak species at a large spatial scale.

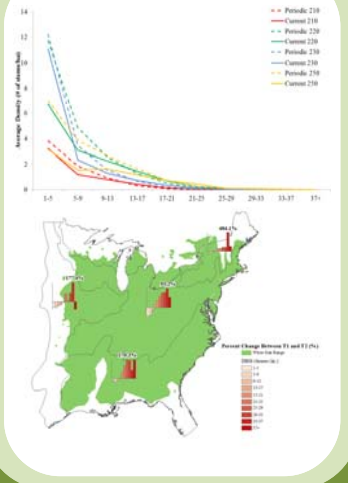
Objective:

To examine the dynamics of nine prevalent oak species across the eastern United States by comparing changes in diameter classes and spatial difference among ecoregions between the 1980s and 2011.

Methods:

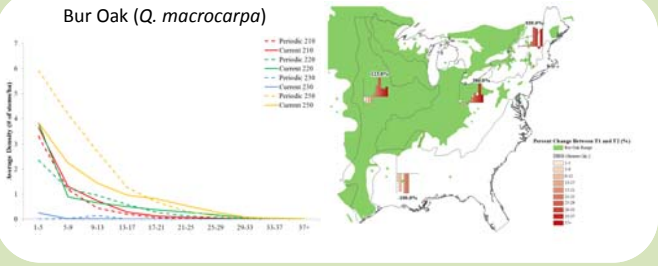
- Forest Inventory and Analysis (FIA) National Program data was used from 37 states.
- Data was obtained from two time periods.
- We found the density for each DBH class in each county in regards to each species.
- Next the average density was found for each DBH class in each ecoregion.
- We used the averages to find the percent differences of each DBH class in each ecoregion.

White Oak (*Q. alba*)

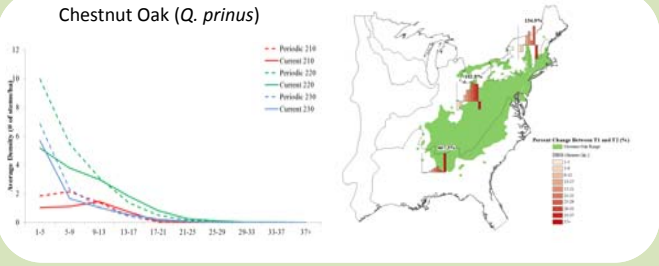


Time Frame: **Periodic**=1980-1995 (depending on the state), **Current**=2011
Ecoregions: **210**=Northern Hardwood, **220**=Central Hardwood, **230**=Southern Pine-Hardwood, **250**=Forest-Prairie Transition

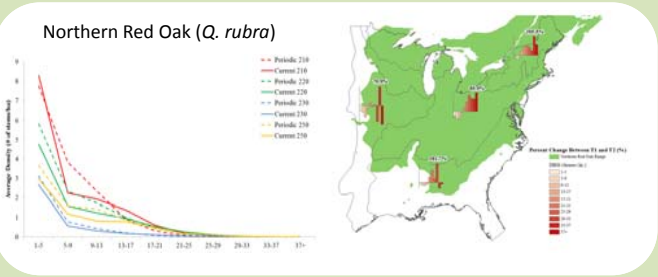
Bur Oak (*Q. macrocarpa*)



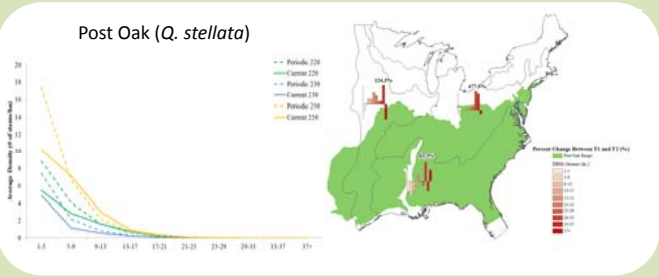
Chestnut Oak (*Q. prinus*)



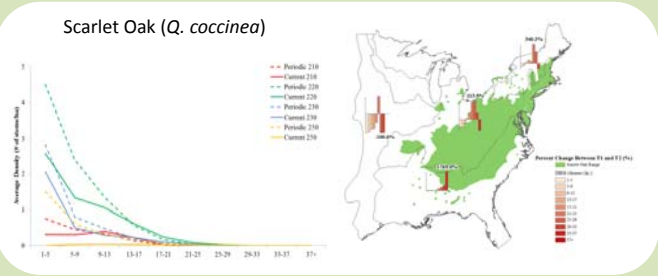
Northern Red Oak (*Q. rubra*)



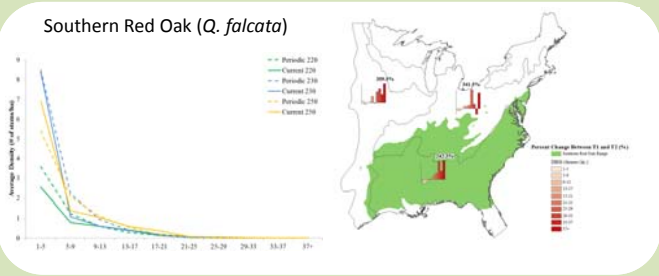
Post Oak (*Q. stellata*)



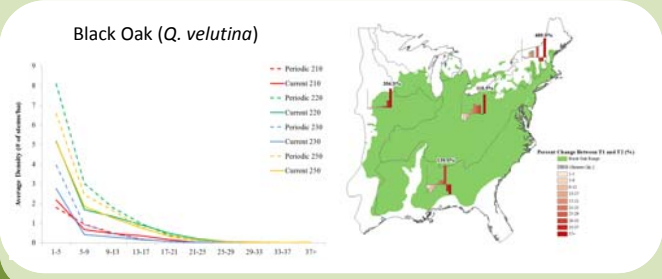
Scarlet Oak (*Q. coccinea*)



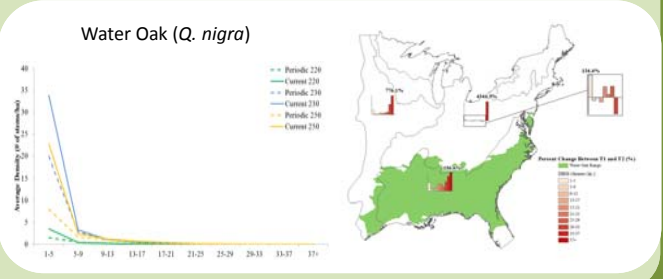
Southern Red Oak (*Q. falcata*)



Black Oak (*Q. velutina*)



Water Oak (*Q. nigra*)



Conclusions:

- In general, for DBH classes less than 15 in. (38 cm) we observe a decline in the last thirty years.
- In general, for DBH classes greater than 15 in. we observe an increase in the last thirty years.
- The largest percent changes tend to be in the larger DBH classes located on the edge of the range, especially in the Northern Hardwood ecoregion. Specifically:
  -northern red oak, white oak, post oak, black oak
- In ecoregions where individual species are only present in small amounts the trend tends to be more erratic. See:
  -bur oak, water oak, southern red oak
- Water oak is the exception to most of the trends. In general there is a consistent increase in water oak.
- In some, species we observe one ecoregion that has a more substantial decline than the other ecoregions in its range. This ecoregion is commonly the Forest-Prairie Transition region or the Central hardwood ecoregion. Examples are:
  -bur oak, scarlet oak, chestnut oak
- In most species we observe a dramatic decline in the number of individuals present between the first (1-5 in.) and second (5-9in.) age classes. See graphs of:
  -southern red oak, water oak, bur oak, northern red oak, black oak, white oak

In conclusion our results support the hypothesis that oaks are having difficulty regenerating due to a decline in young trees.

Acknowledgment:

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