Breeding bird response to fire and other disturbances in eastern hardwood forest

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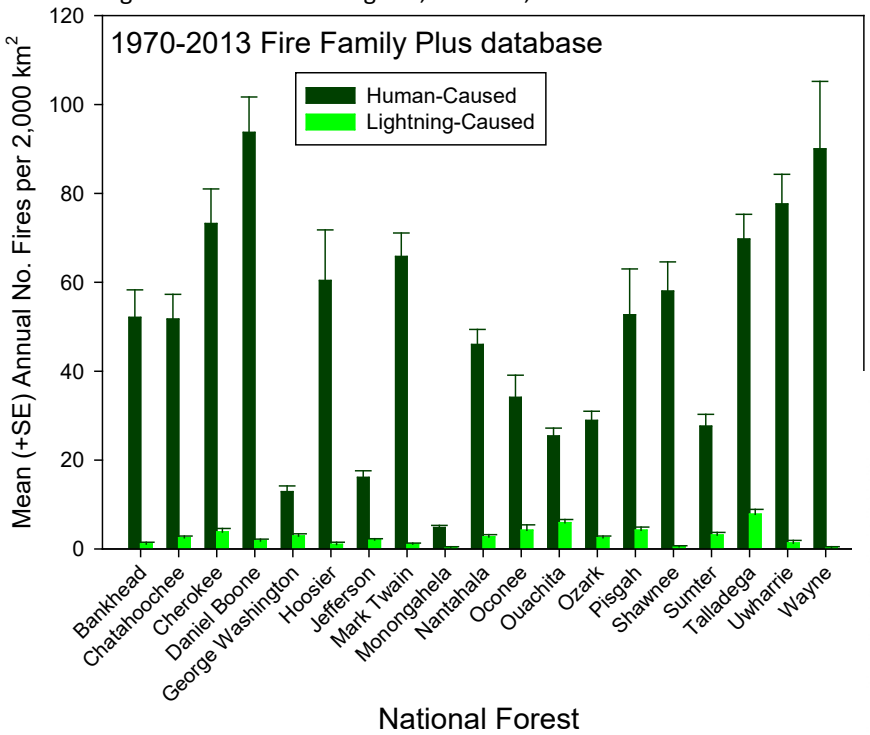
Wildlife species diversity reflects diverse conditions within stands & across the landscape

Diverse forest conditions, historically and today, are largely the result of natural and anthropogenic disturbances including fire

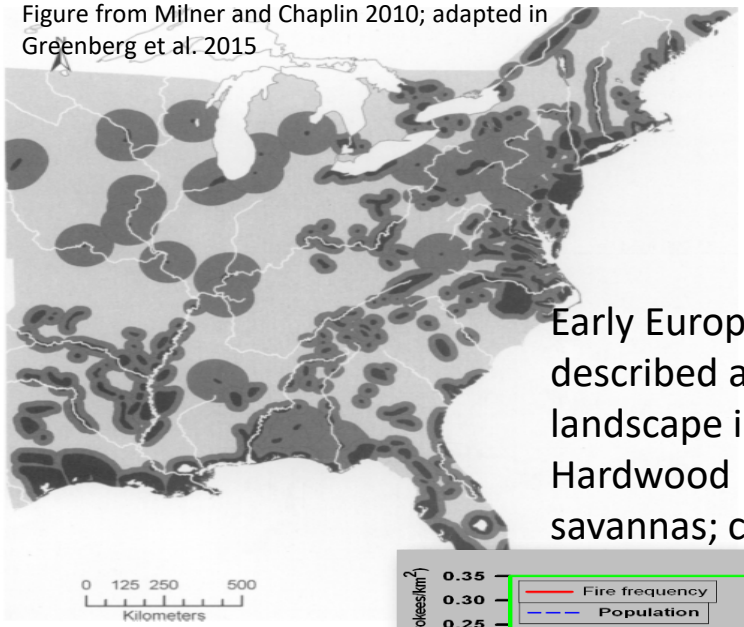
In central hardwood forests, the number of lightning-ignited wildfires is low relative to total wildfires

Figure source: Greenberg CH., Collins B, 2015.

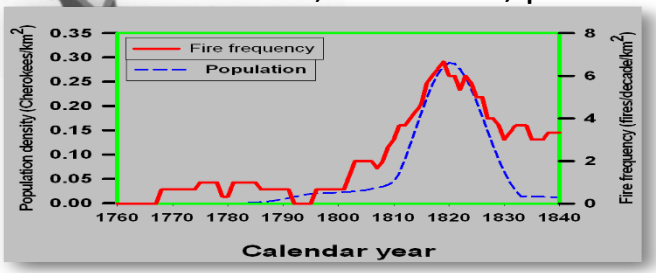


- Lighting frequency lower than Coastal Plain
- Fuel conditions often moist, loadings low
- Longer droughts required to ignite
- Strikes, ignition may be more frequent on ridges, dry S, SW, or W-facing slopes

Figure from Milner and Chaplin 2010; adapted in Greenberg et al. 2015



Early European Explorers described a very different landscape in the Central Hardwood Region… "open; savannas; clear land; plains"



(Figure adapted from Guyette et al. 2006)

Whether lightning- or human-ignited, fire behavior and severity varies, create a gradient of conditions

- Topography
- Fuel loading & condition
- Weather

Fire & Fire Surrogate Study: low-intensity (B) versus high-severity (MB) prescribed Fires

Forest Service

Lessons learned from research on fire, silviculture, and breeding birds in the southern Appalachians

- Low- vs high-severity repeated dormant-season Rx
- Rx vs shelterwood harvests
- Season of burn
- Mixed-severity wildfire
- Shelterwood harvests: Changes as forests mature

Breeding Bird Response to Fuel Reduction Treatments in the Southern Appalachians

Partnership: USFS Southern Research Station, North Carolina Wildlife Resources Commission, North Carolina State University

Fire & Fire Surrogate Study

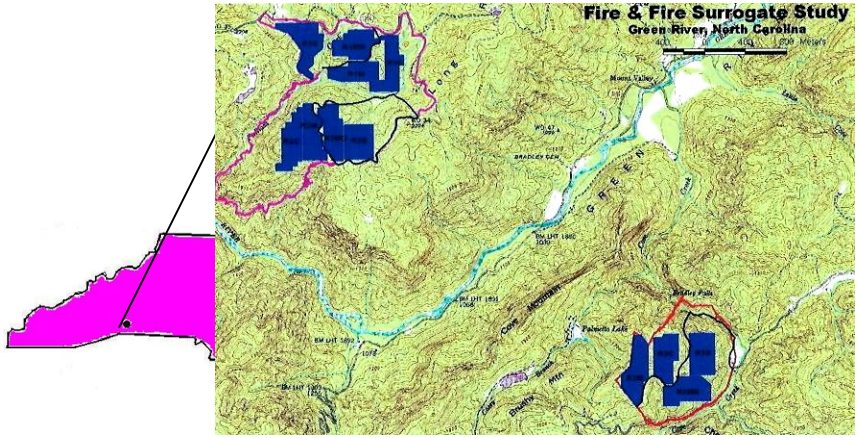
TREATMENTS

Randomized block design; n=3

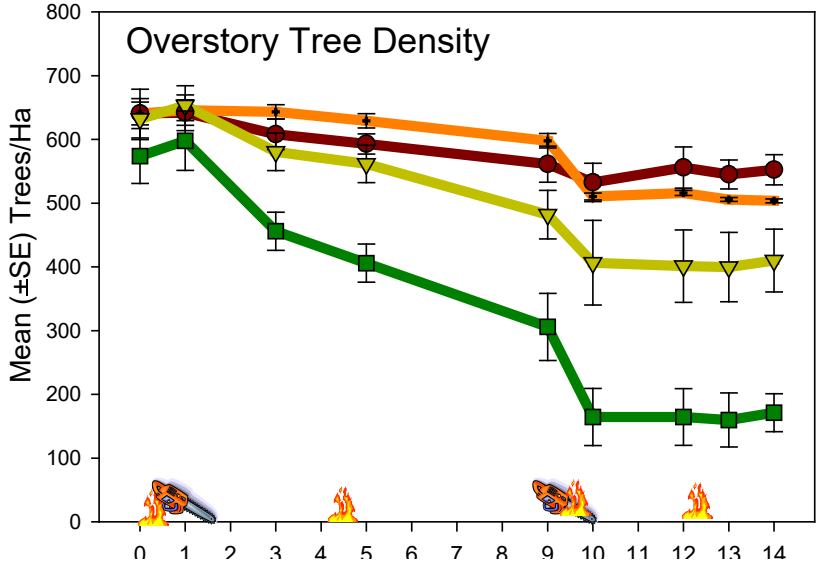
- Mechanical understory reduction
- Repeated low-intensity burns (4)
- Mechanical + four repeated burns
- Control

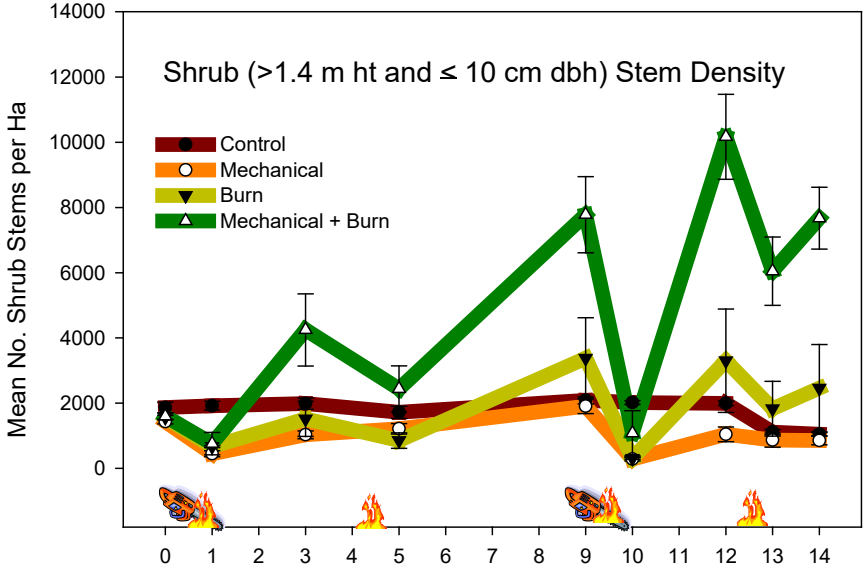
Breeding Birds sampled using 50-m radius point counts, 3x during breeding season

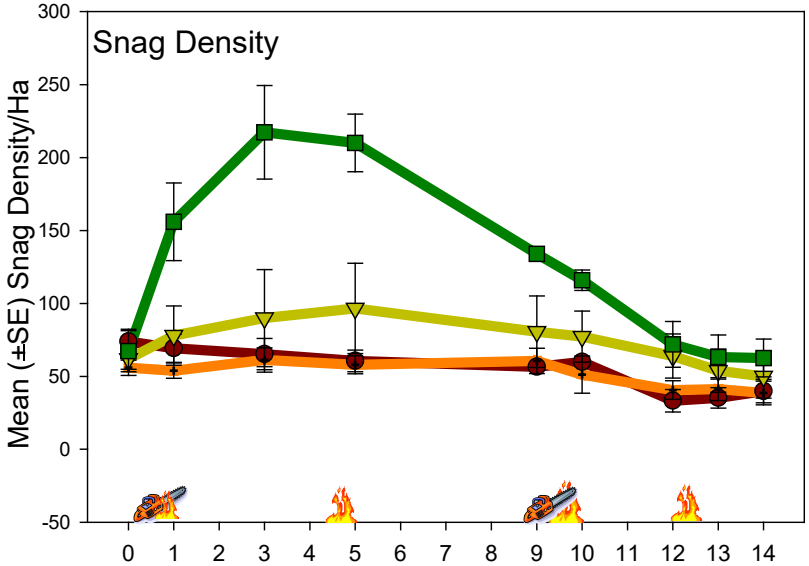
- 5,841-ha Green River Game Lands
- Elevation: 366 - 793 m
- Oak-hickory, pine on ridges
- Not thinned or burned >50 years

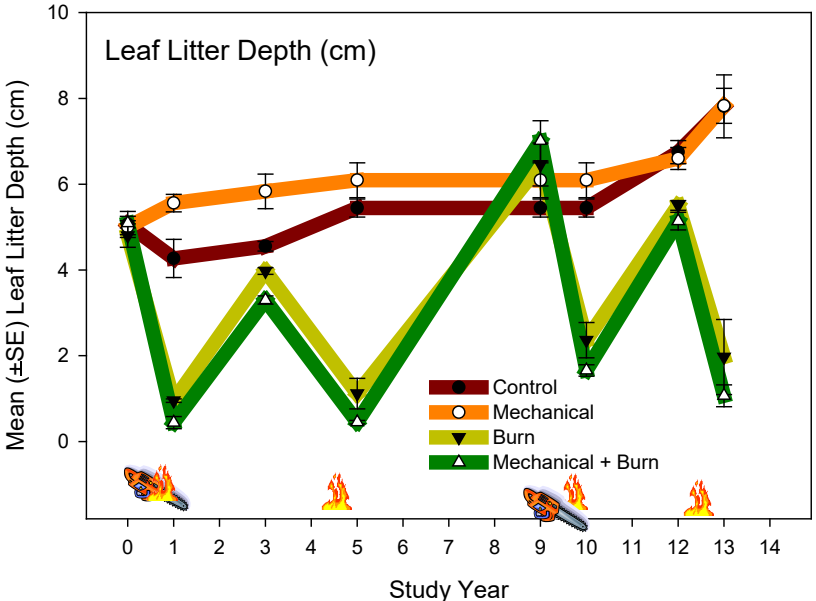


Forest structure after fuel reduction treatments









Forest structure before and after repeated low-intensity winter prescribed burns

- A few ‘hot spots’ killed larger trees, creating canopy gaps
- Reduction in midstory

Mechanical + Burn Structure

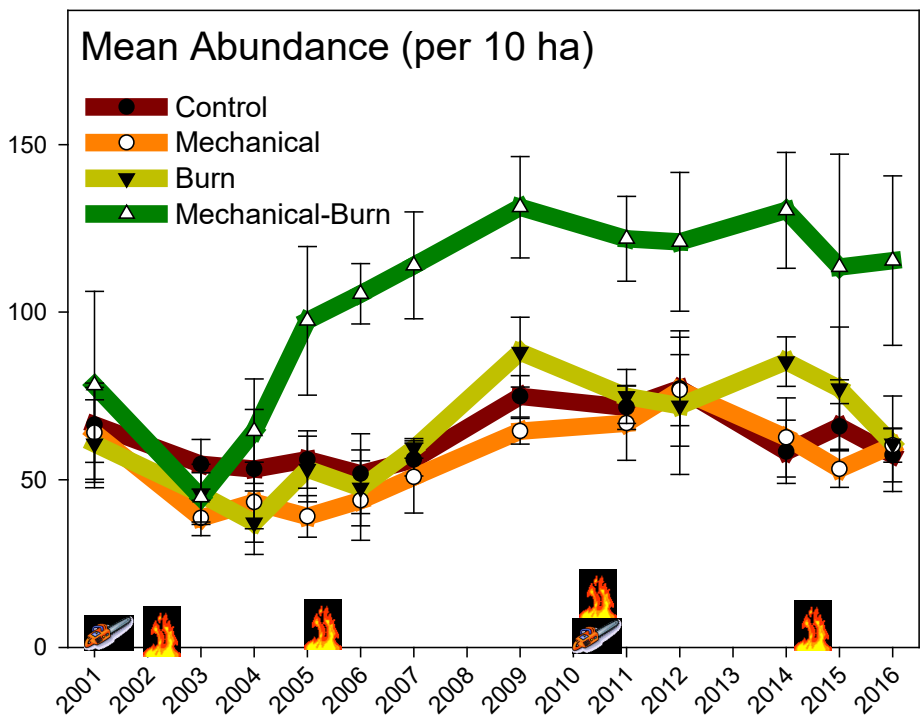
Mechanical + Burn: Pretreatment

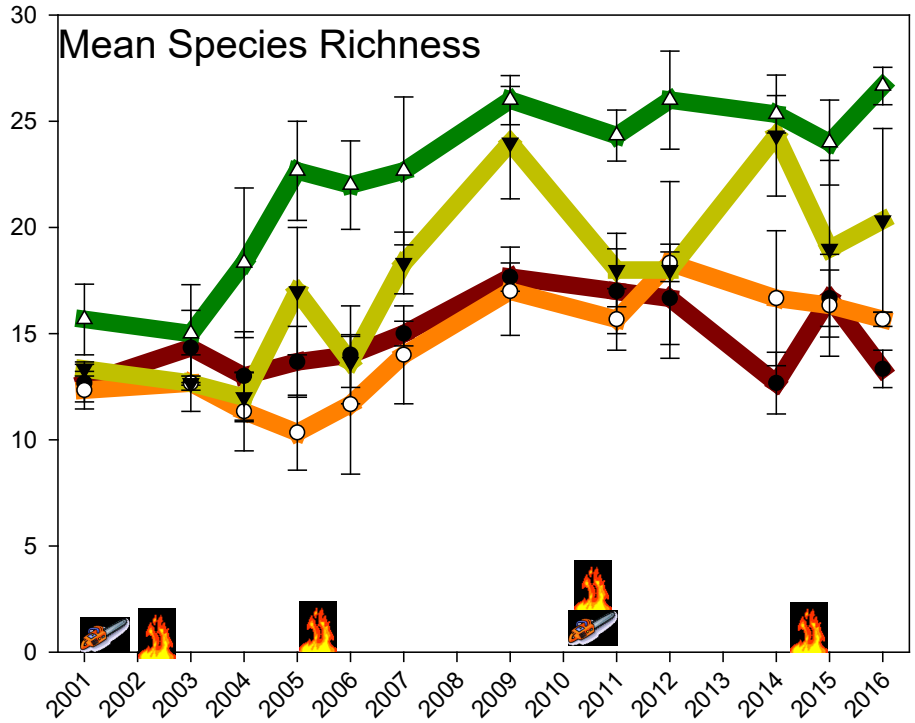
Mechanical + Burn: 3 years post treatment

Mechanical + Burn: 5 years post treatment
1 year post 2nd burn

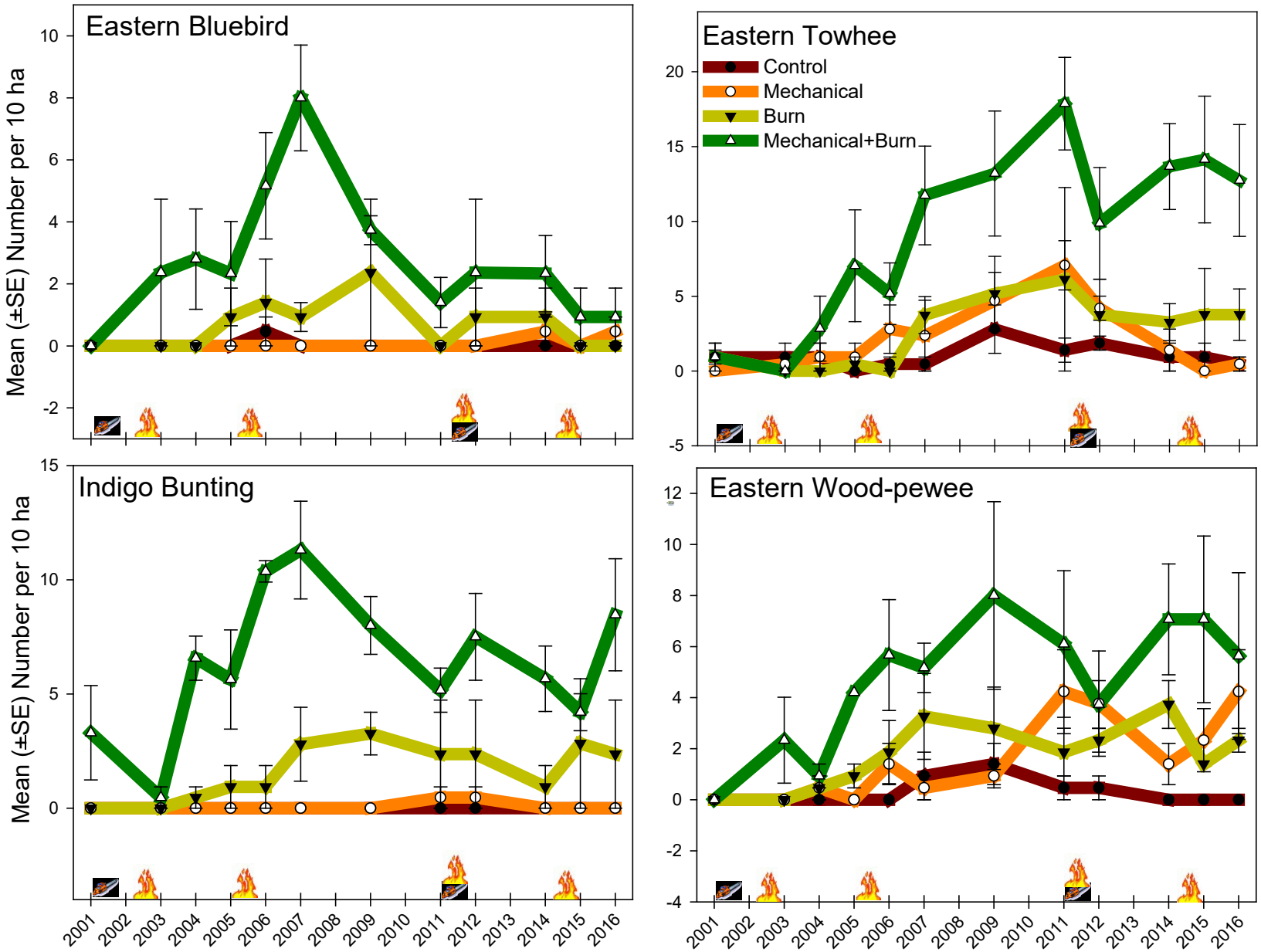
Mechanical + Burn: 12 years post treatment
1 year post 3rd burn

Breeding bird abundance & species richness greater in the high-severity burn (MB)

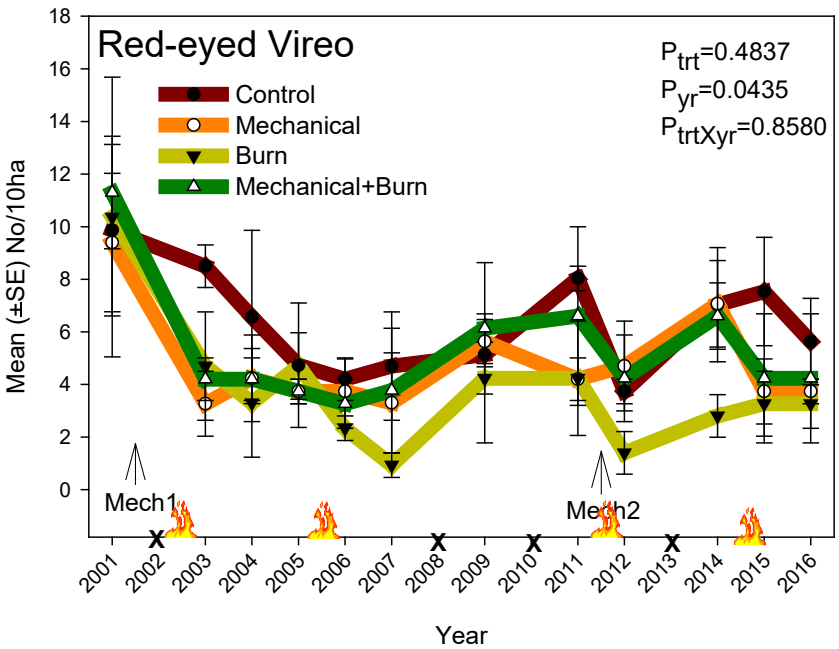


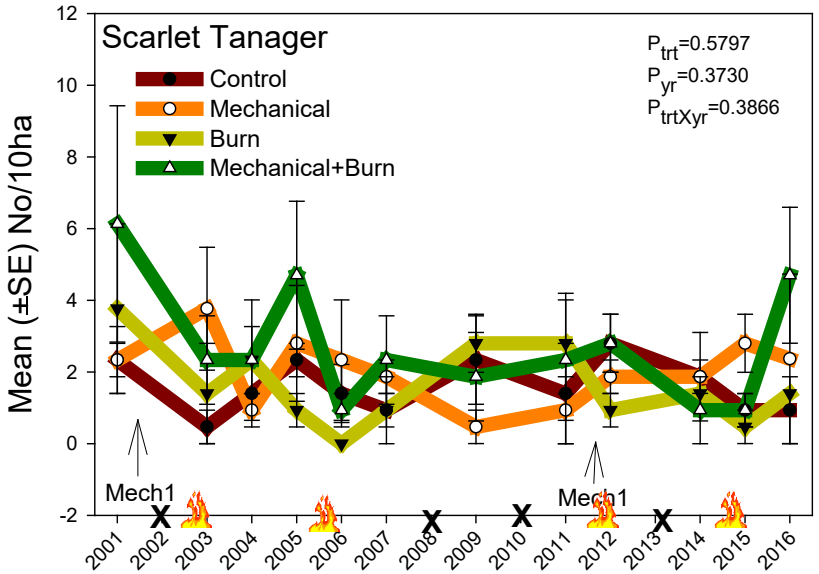


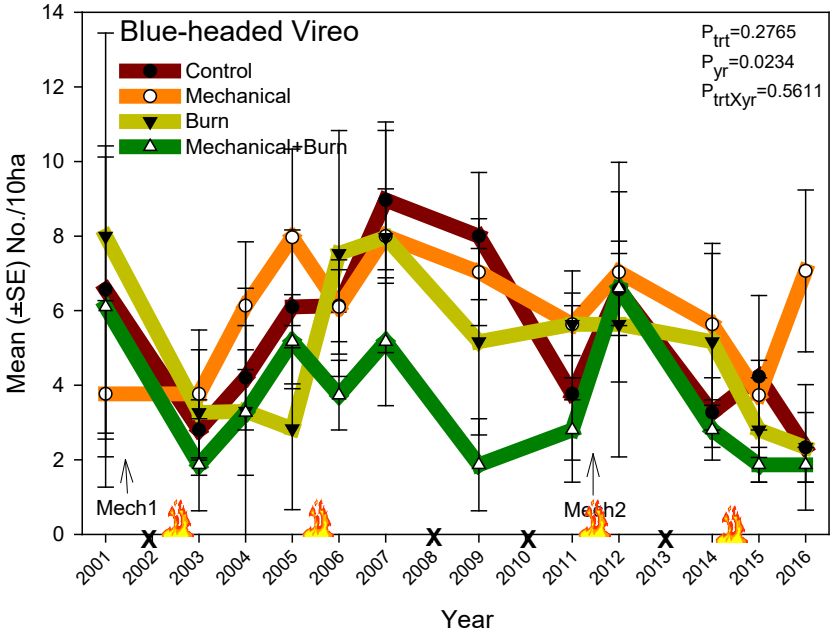
Abundance of several species increased after high-severity burns (MB)



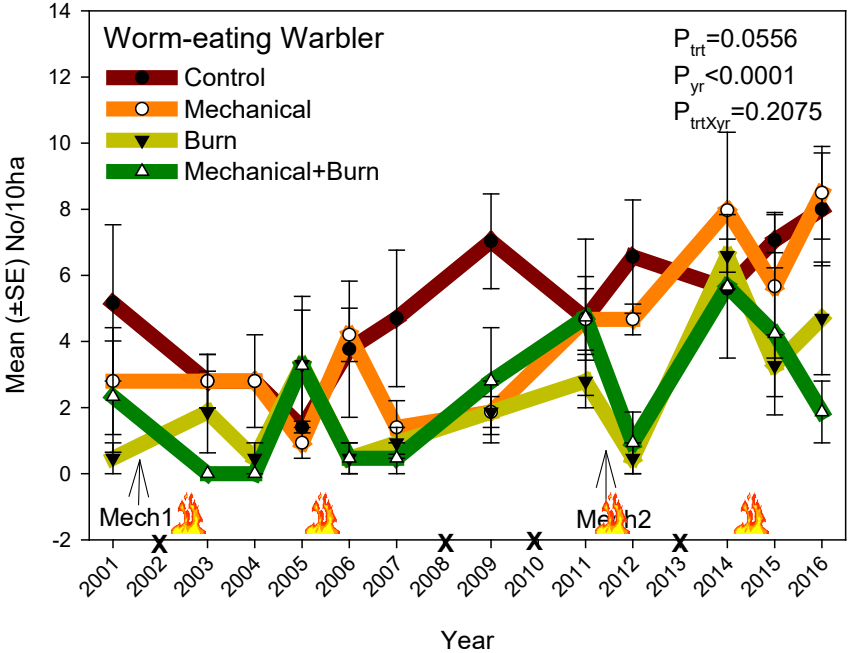
Others showed no response to treatments

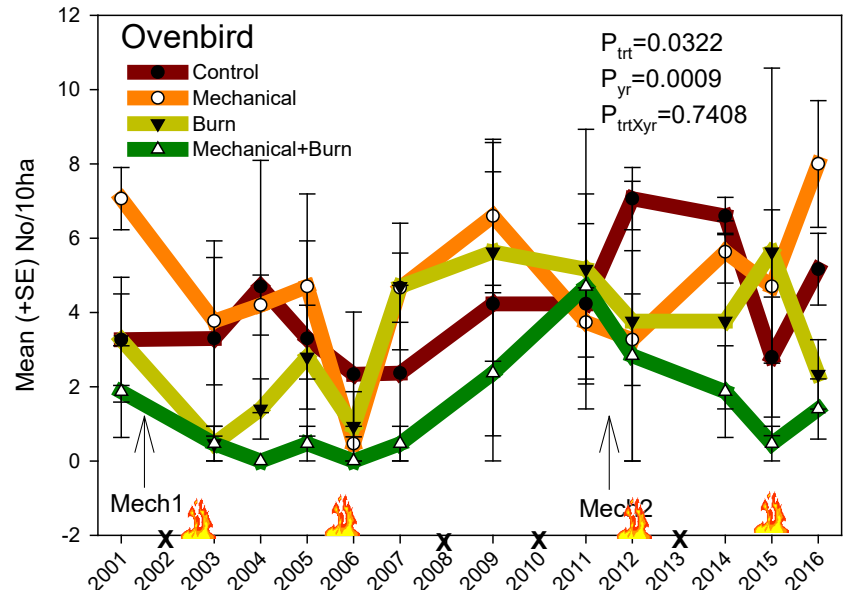


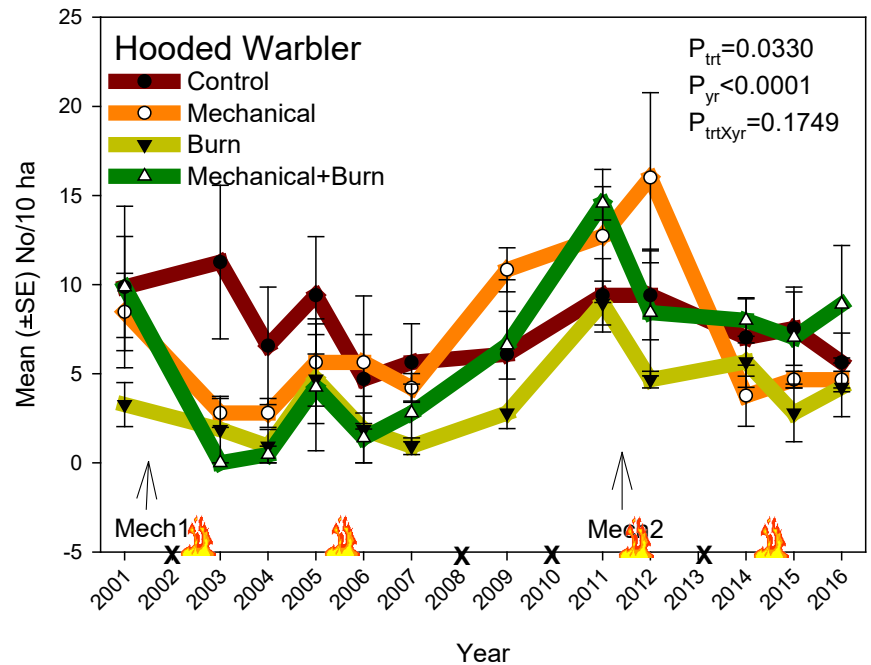




Some showed short-term negative response







- Fewer WEWA in MB than C
  - Pattern of < after burns?
- Fewer OVEN in MB than M
- Fewer HOWA in B than C

Breeding Bird Response to Oak Regeneration Silviculture Treatments in the Southern Appalachians

Partnership: USFS Southern Research Station, North Carolina Wildlife Resources Commission

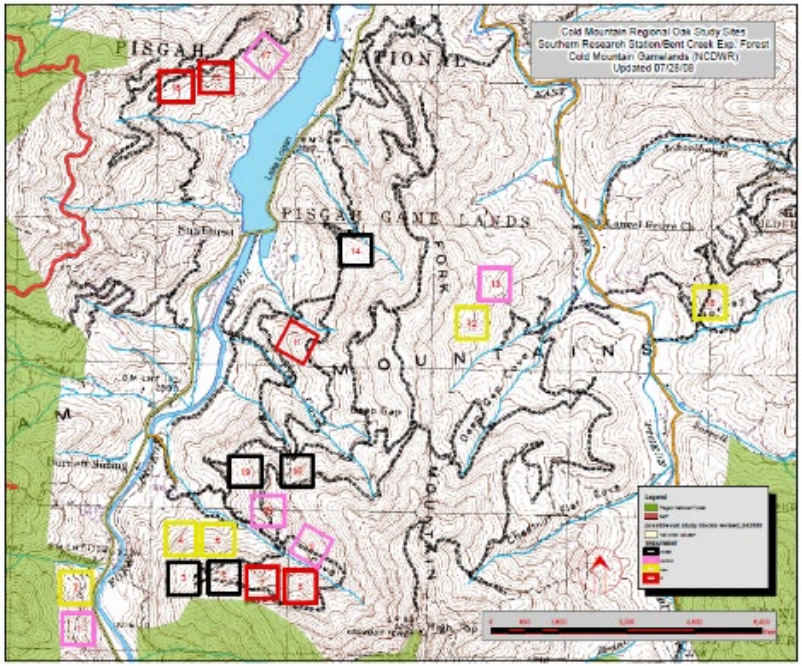
Regional Oak Study

Treatments alter light, hardwood competition to promote oak regeneration:

Completely randomized design; n=5

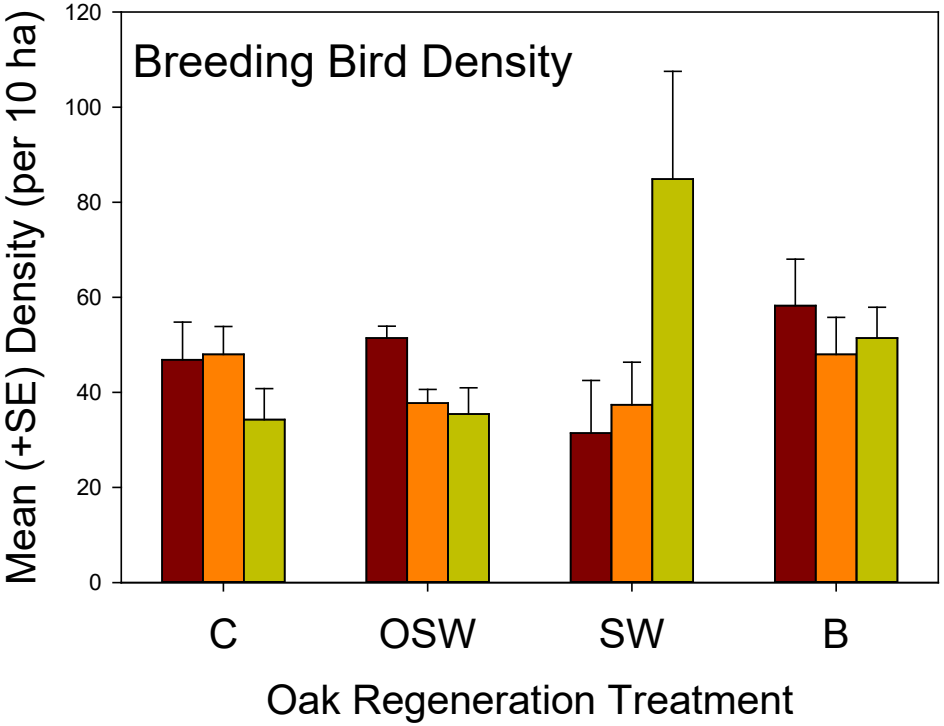
Breeding birds: strip transects 2x/ breeding season

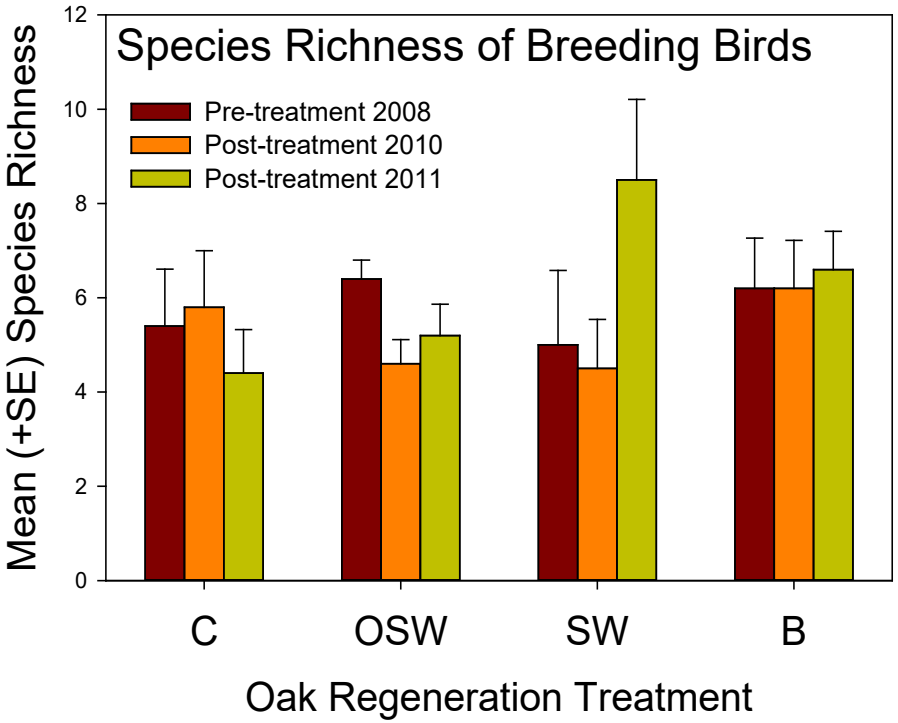
- B: Prescribed burn
- SW: Shelterwood (65% basal area reduction)
- OSW: Oak shelterwood (midstory herbicide)
- C: Control



Bird response to oak regeneration treatments

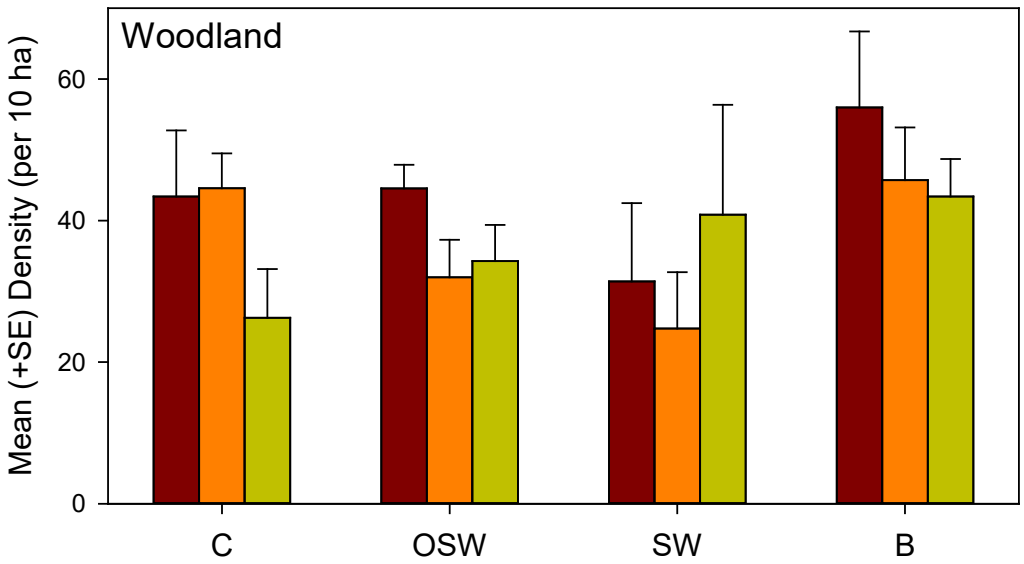
- Species richness and abundance delayed increased in shelterwoods
- Low-intensity, dormant-season prescribed burning had little effect

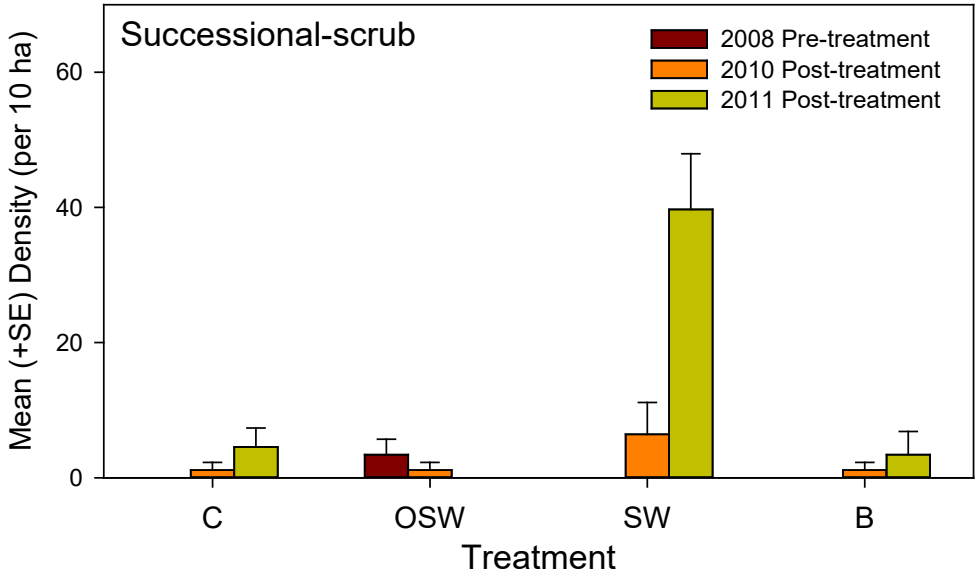




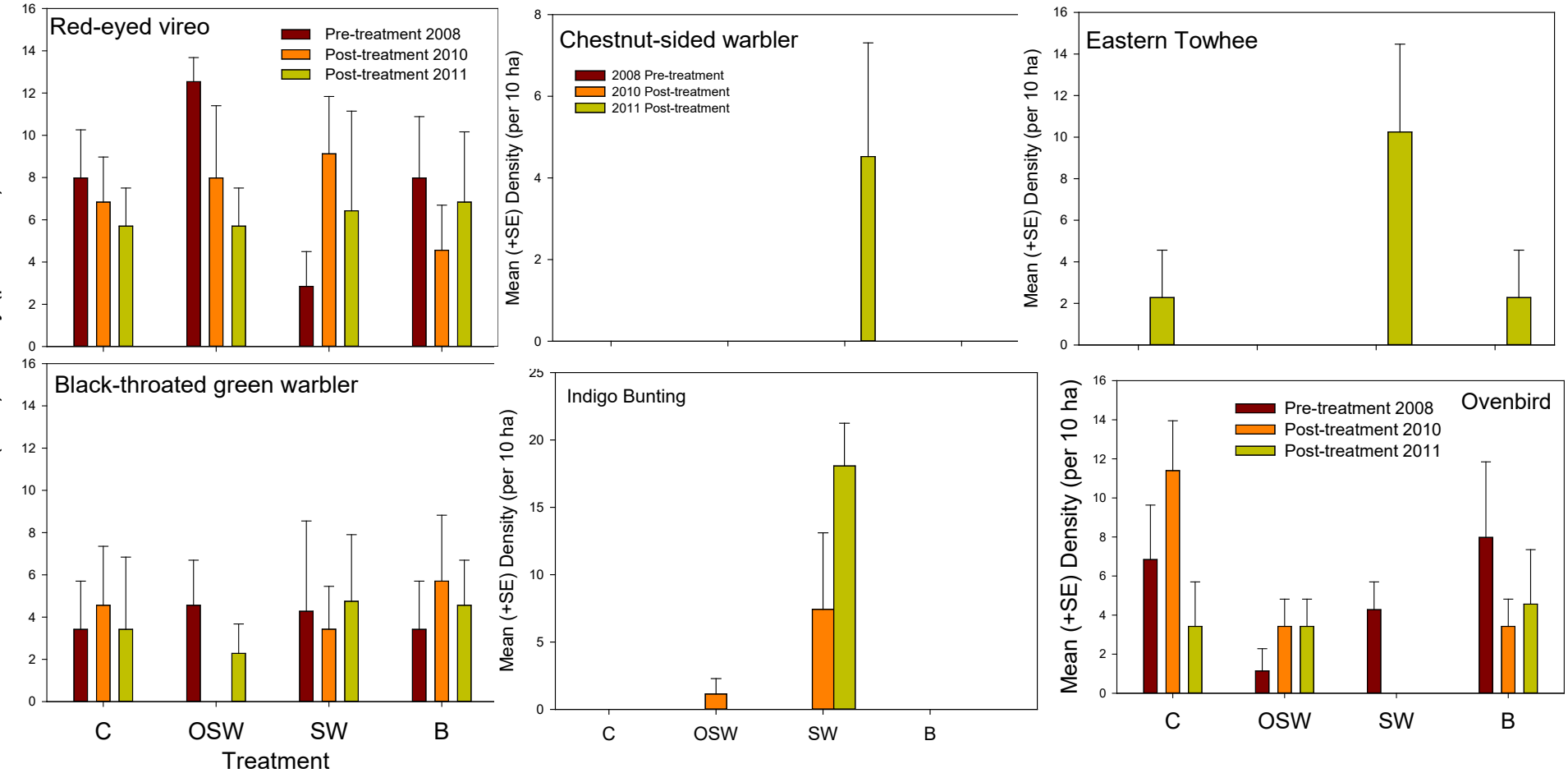
C.H. Greenberg, K. Franzreb, T.L. Keyser, S. Zarnoch, D.M. Simon, G.S. Warburton, 2014

Little change in Rx units…
Large increase in shrubland birds in shelterwood units





Bird species responded differently to treatments

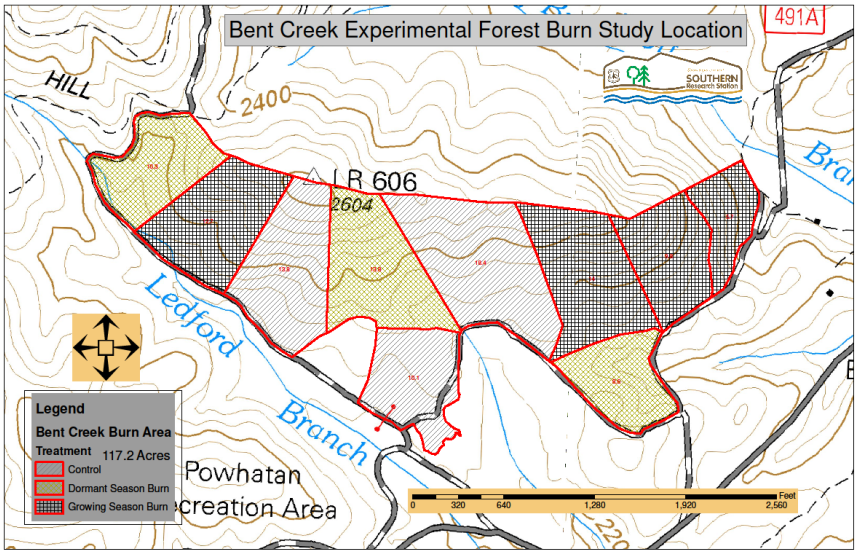


C.H. Greenberg, K. Franzreb, T.L. Keyser, S. Zarnoch, D.M. Simon, G.S. Warburton, 2014

Breeding Bird Response to Season of Burn in the Southern Appalachians

Partnership: USFS Southern Research Station, Pisgah District, Pisgah National Forest,

Season of Burn Study



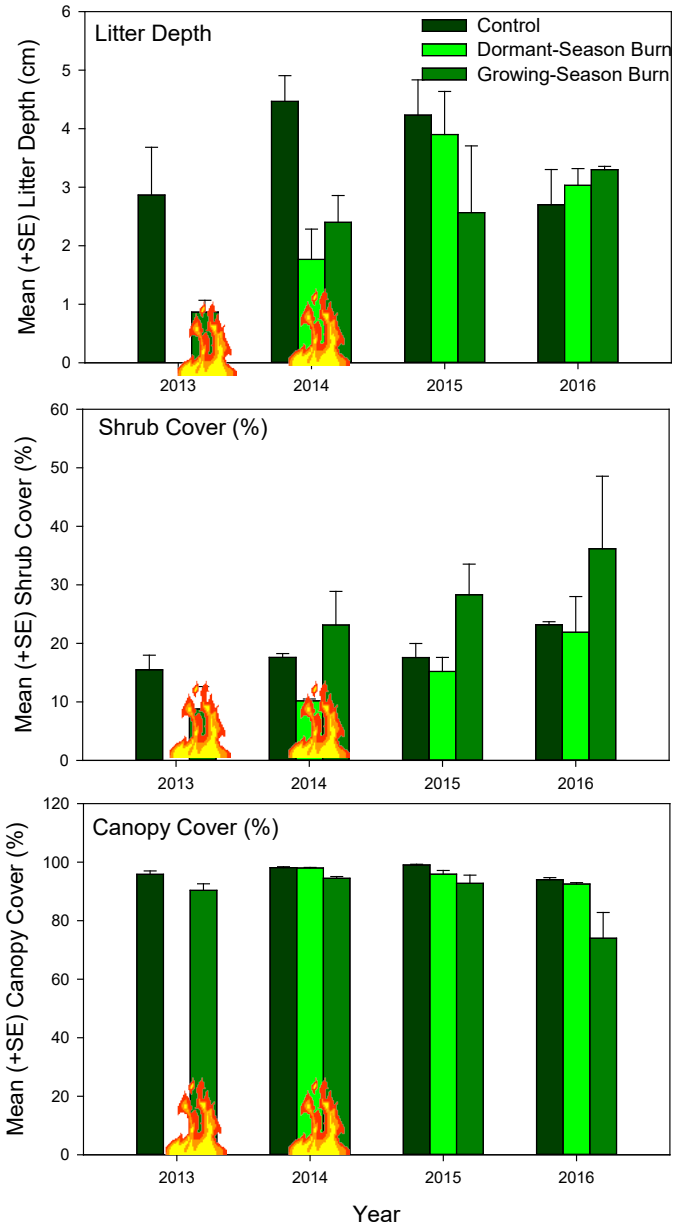
Treatments (n=3)

- **Growing-season burns (4/26/2013)**
  Dormant-season burns (3/5/2014)
  Unburned controls

Breeding birds sampled along strip transects 2x per breeding season

Forest structure: Prescribed burns had minimal and short-term effects, regardless of season burned

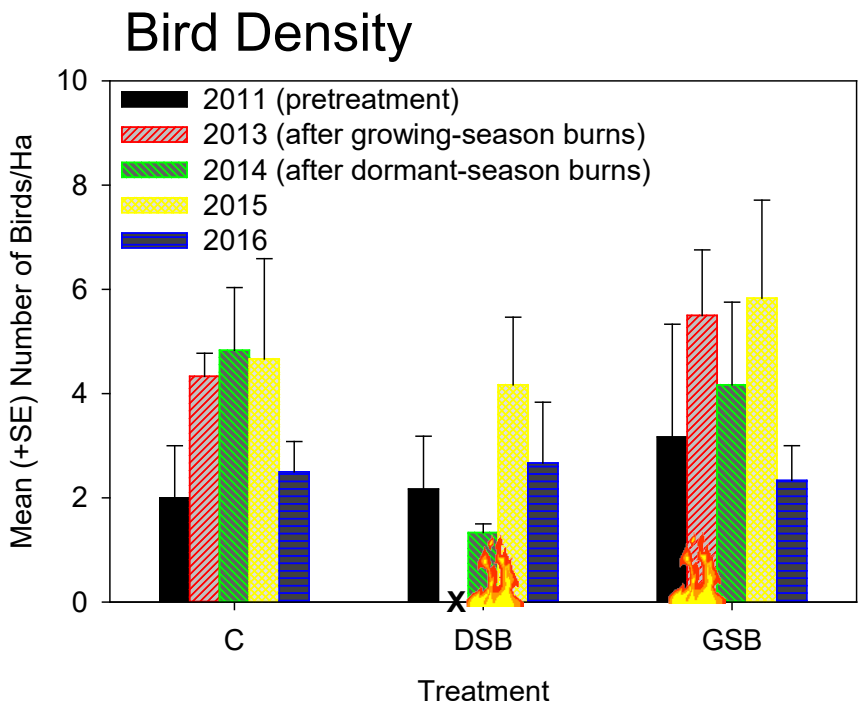
- Leaf litter decreased after burns but recovered rapidly
- Shrub cover was reduced after burns but increased over time
- Canopy cover decreased slightly over time in growing-season burns. Some mortality occurred in 'hot spots'.

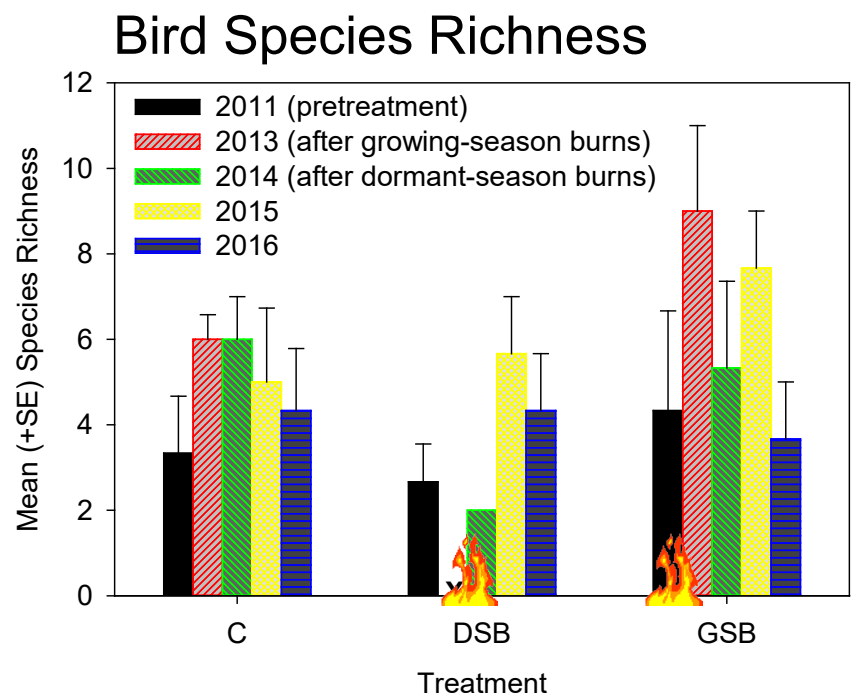


Greenberg, C.H., T. Seiboldt, T.L. Keyser, W.H. McNab, P. Scott, J. Bush, C.E. Moorman. 2018.

Season of burn effects on breeding birds

- Prescribed burns did not substantially affect breeding bird abundance or species richness, regardless of season burned
- Observed a few canopy gaps in GSB where “hot spots” killed tree(s) and bird richness appeared higher





C.H. Greenberg, T.L. Keyser, H. McNab, P. Scott (2019).

Breeding Bird Response to Mixed-Severity Wildfire in the Southern Appalachians

Partnership: USFS Southern Research Station, North Carolina State University, Southern Appalachian Raptor Research -C.H. Greenberg, C.E. Moorman, K.J. Elliott, K.L. Martin, M. Hopey

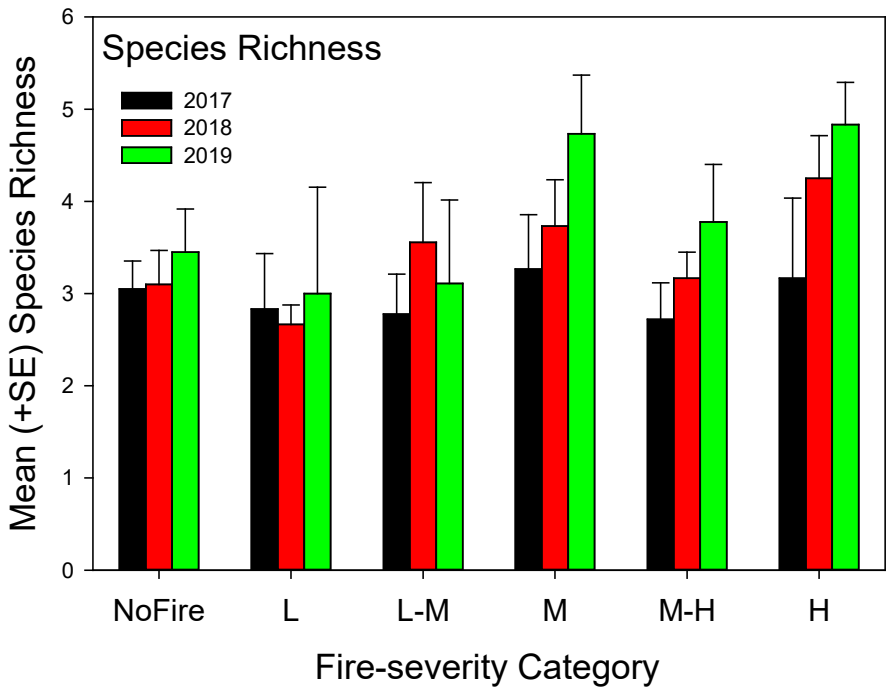
Wildfire & Breeding Birds

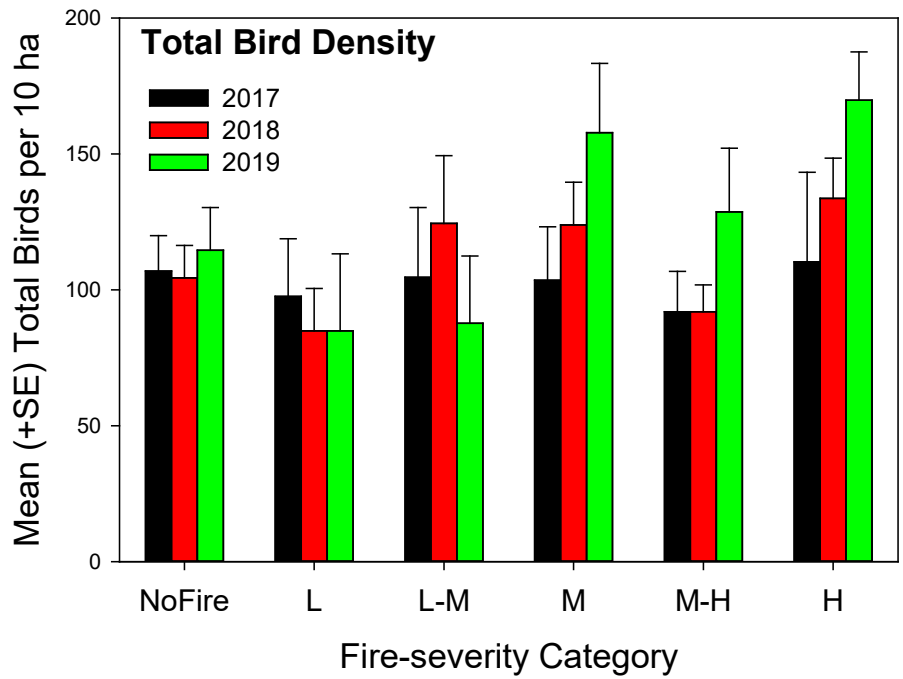
- Nantahala National Forest
- 3 burned watersheds (2016)
  - Fire-severity gradient
- 3 unburned watersheds
- Bird point counts (2x)
  - 2017, 2018, 2019

Partnership: Coweeta Hydrologic Lab, North Carolina State University, USFS Southern Research Station, USFS NF's NC, & Southern Appalachian Raptor Research

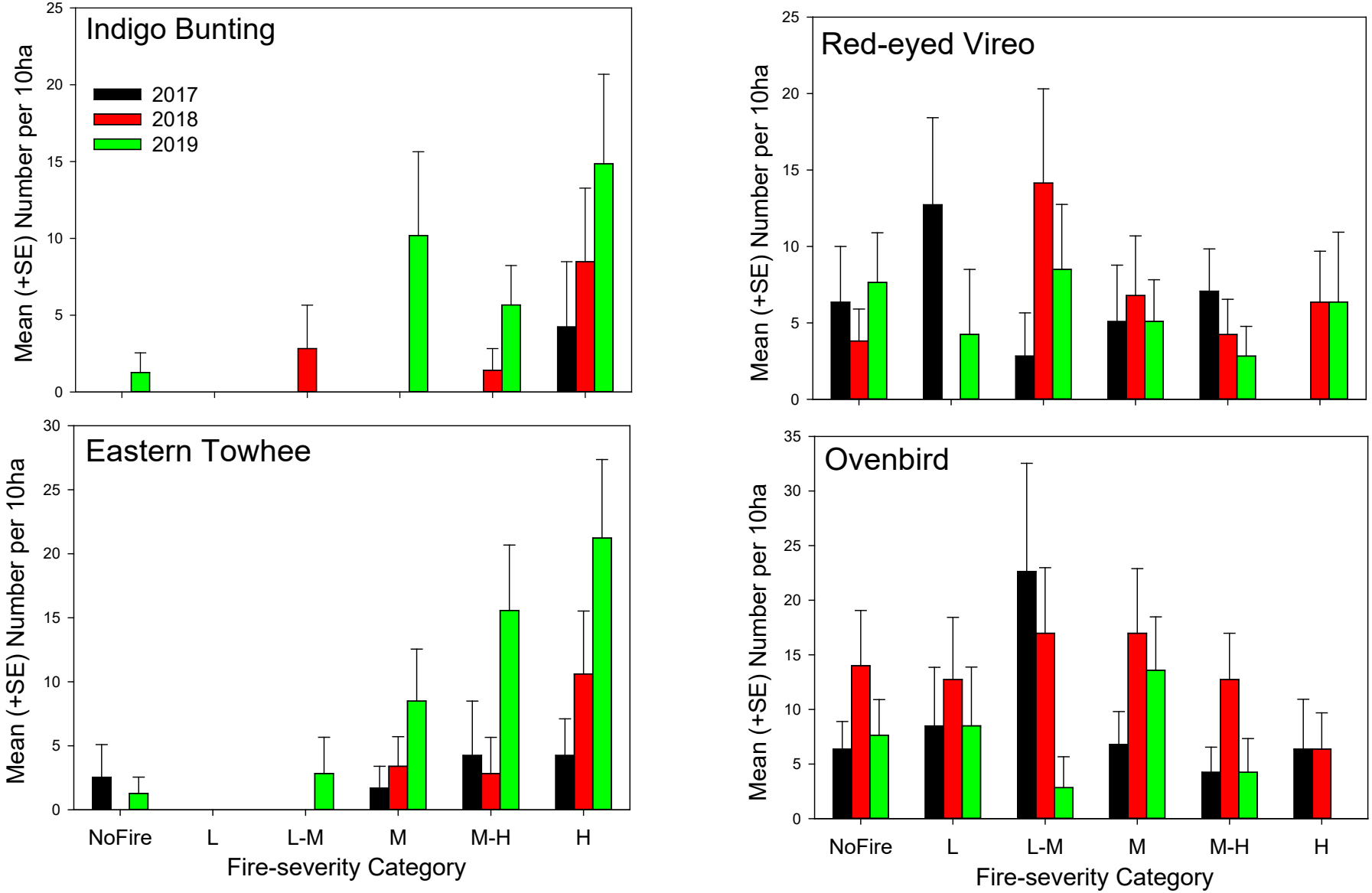
Preliminary data: Breeding bird species richness and abundance is increasing with wildfire severity

Other studies show that breeding bird response may be delayed as more trees die and canopy cover decreases after high-severity burns





Disturbance-dependent bird species appear to be responding to higher-severity wildfire



Long-term Breeding Bird Response to Shelterwood harvests in Cove- and Upland Hardwood Southern Appalachian Forests

C.H. Greenberg, J. Tomcho, M. Whitehead, J.D. Lanham

Partnership: USFS Southern Research Station & Clemson University

Shelterwood Harvests & Breeding Birds

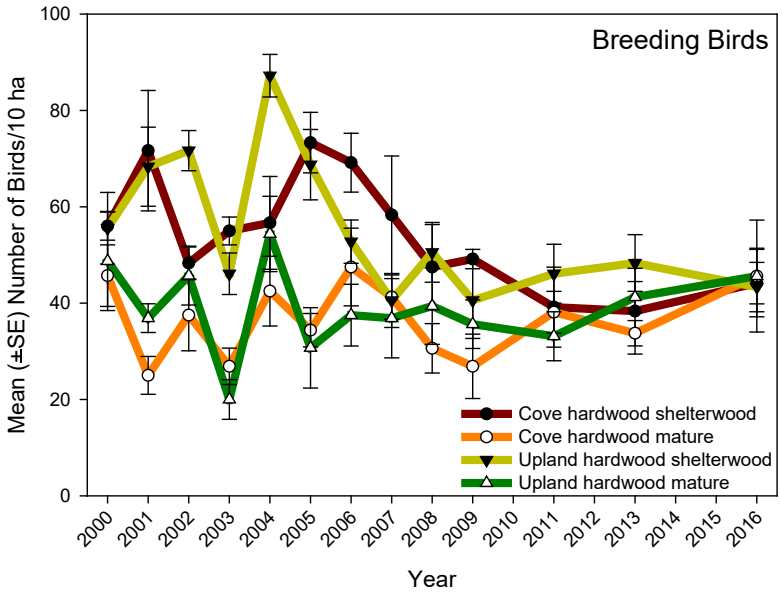
- Pisgah National Forest
- Completely randomized design
- N=15 shelterwood harvests (ca. 1999)
- N=16 mature forest controls
- Cove and upland hardwood forest types

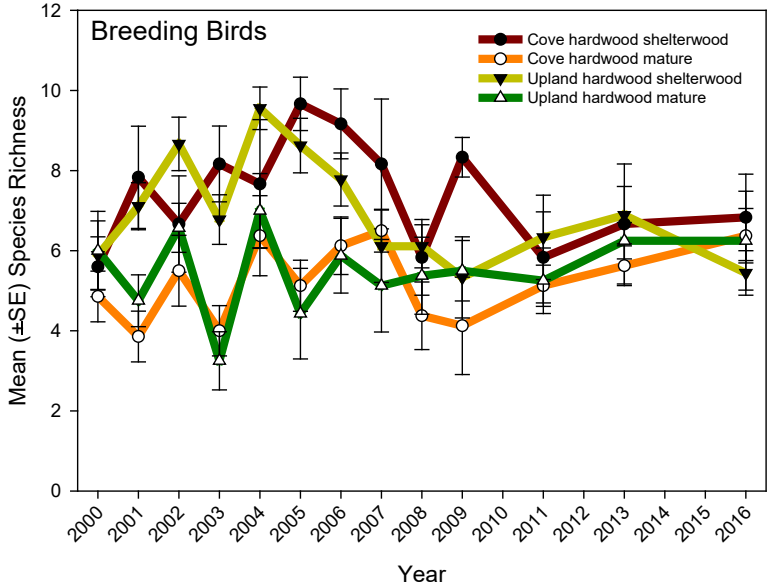
Breeding birds sampled along strip transects 1x per breeding season

2000-2009, 2011, 2013, 2016

Change in young forest structure 1999-2005

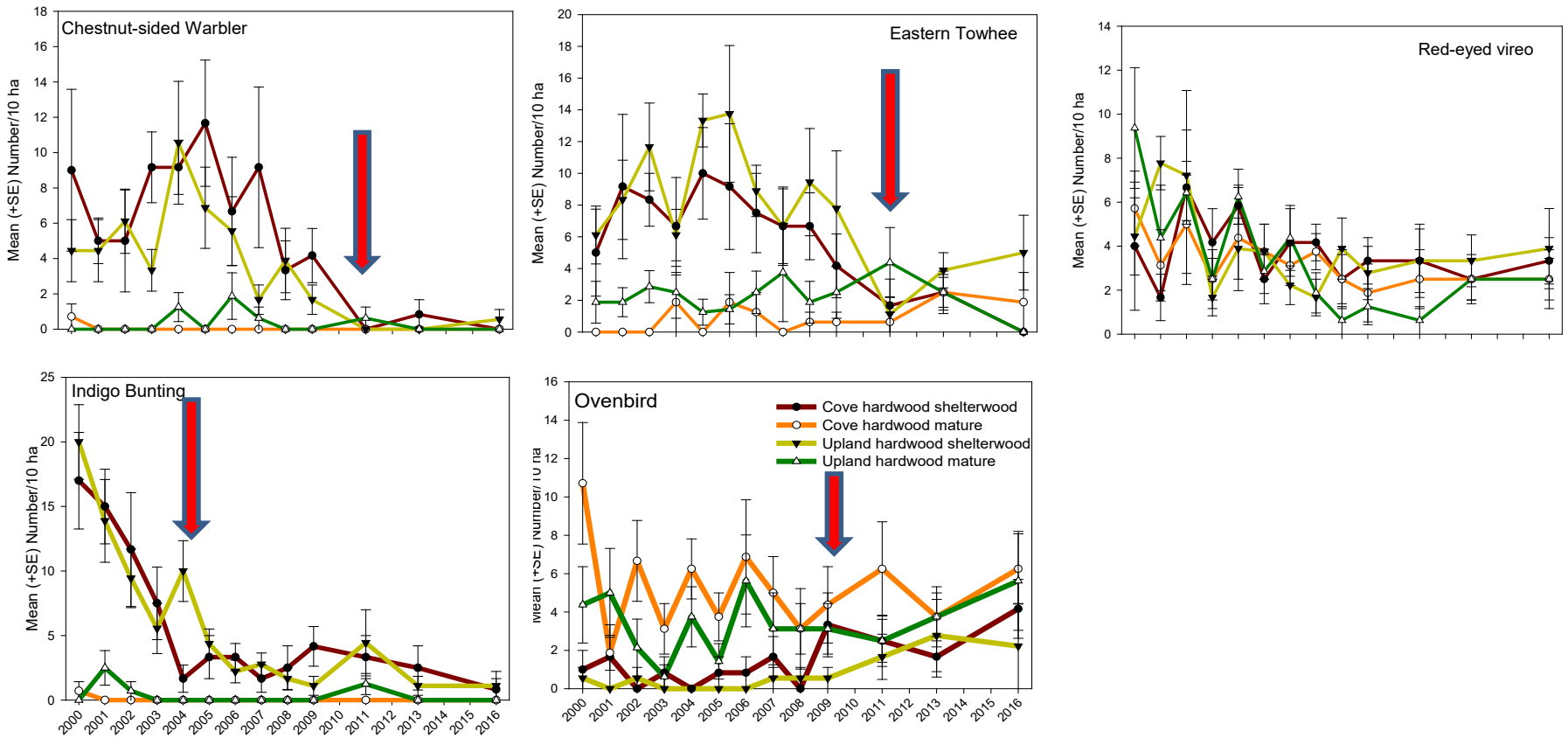
Preliminary results – breeding birds





- Abundance greater in SW
- Richness greater in SW
- Response to SW lasts ca. 9 ys

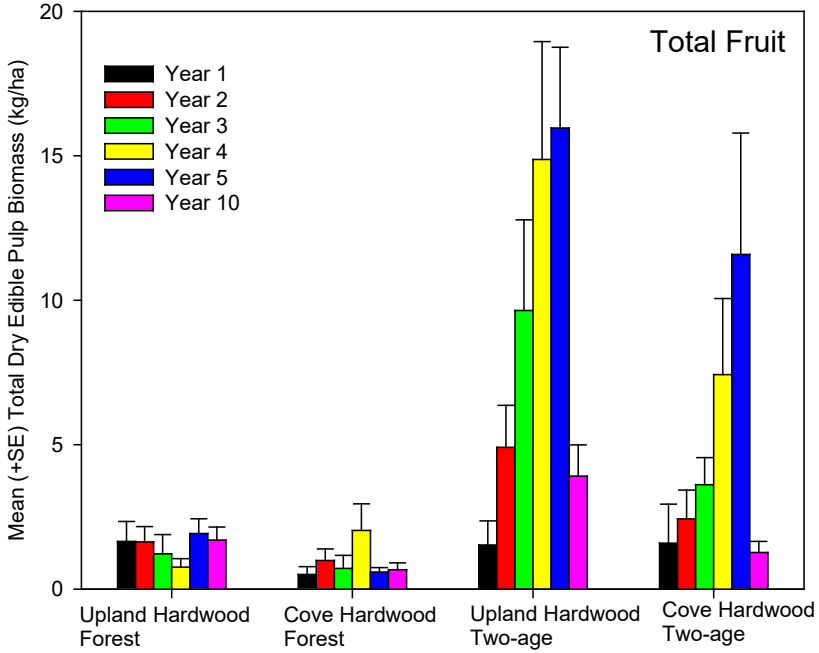
Preliminary results – breeding birds



- **Species differ in their responses to shelterwood harvests**
- **Treatment differences subsided within 5-8 years**
- **Habitat suitability changed over time, and differed among species**

So, what is it about open, young-forest conditions?

- Reduced forest canopy cover
- More light, primary productivity
- Thick cover
- More flying/foliar insects
- More native fruit production



Taken together, study results are showing patterns of responses to forest structures created by fire or silviculture

- Forest canopy cover appears to be a primary driver of breeding bird responses
- Reduced canopy cover results in greater bird abundance, species richness
- Species respond differently to reduced canopy cover (>, <, or no change)
- Little response to shrub- or midstory removal alone
- Little response to low-intensity burns regardless of season if canopy intact
- Substantial response to high-severity burns
- Open-forest conditions last < 10 years following disturbances
- Repeated burning can prolong open conditions
- Forest management and high-severity fire can create open-forest conditions

Citations in presentation

- Greenberg, Cathryn H., Tara L. Keyser, W. Henry McNab, and Patrick Scott. Breeding bird response to season of burn in an upland hardwood forest. *Forest Ecology and Management* 449 (2019): 117442.
- Greenberg, Cathryn H., Joseph Tomcho, Aimee Livings-Tomcho, J. Drew Lanham, Thomas A. Waldrop, Dean Simon, and Donald Hagan. Long-term avian response to fire severity, repeated burning, and mechanical fuel reduction in upland hardwood forest. *Forest ecology and management* 424 (2018): 367-377.
- Greenberg, Cathryn H., Kathleen E. Franzreb, Tara L. Keyser, Stanley J. Zarnoch, Dean M. Simon, and Gordon S. Warburton. Short-term response of breeding birds to oak regeneration treatments in upland hardwood forest. *Natural Areas Journal* 34, no. 4 (2014): 409-422.
- Greenberg C.H., B.S. Collins (eds.) 2015. Natural Disturbances and Historic Range of Variation: Type, Frequency, Severity, and Post-Disturbance Structure in Central Hardwood Forests, USA. Springer, Managing Forest Ecosystem Series, vol. 32.
- Greenberg, Cathryn, Beverly Collins, and Frank Thompson III, eds. Sustaining Young Forest Communities: Ecology and Management of early successional habitats in the central hardwood region, USA. Vol. 21. Springer Science & Business Media, 2011.

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