

Density and fitness of *Ctenus hibernalis* (Aranea: Ctenidae) in a montane longleaf pine ecosystem undergoing restoration

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Introduction

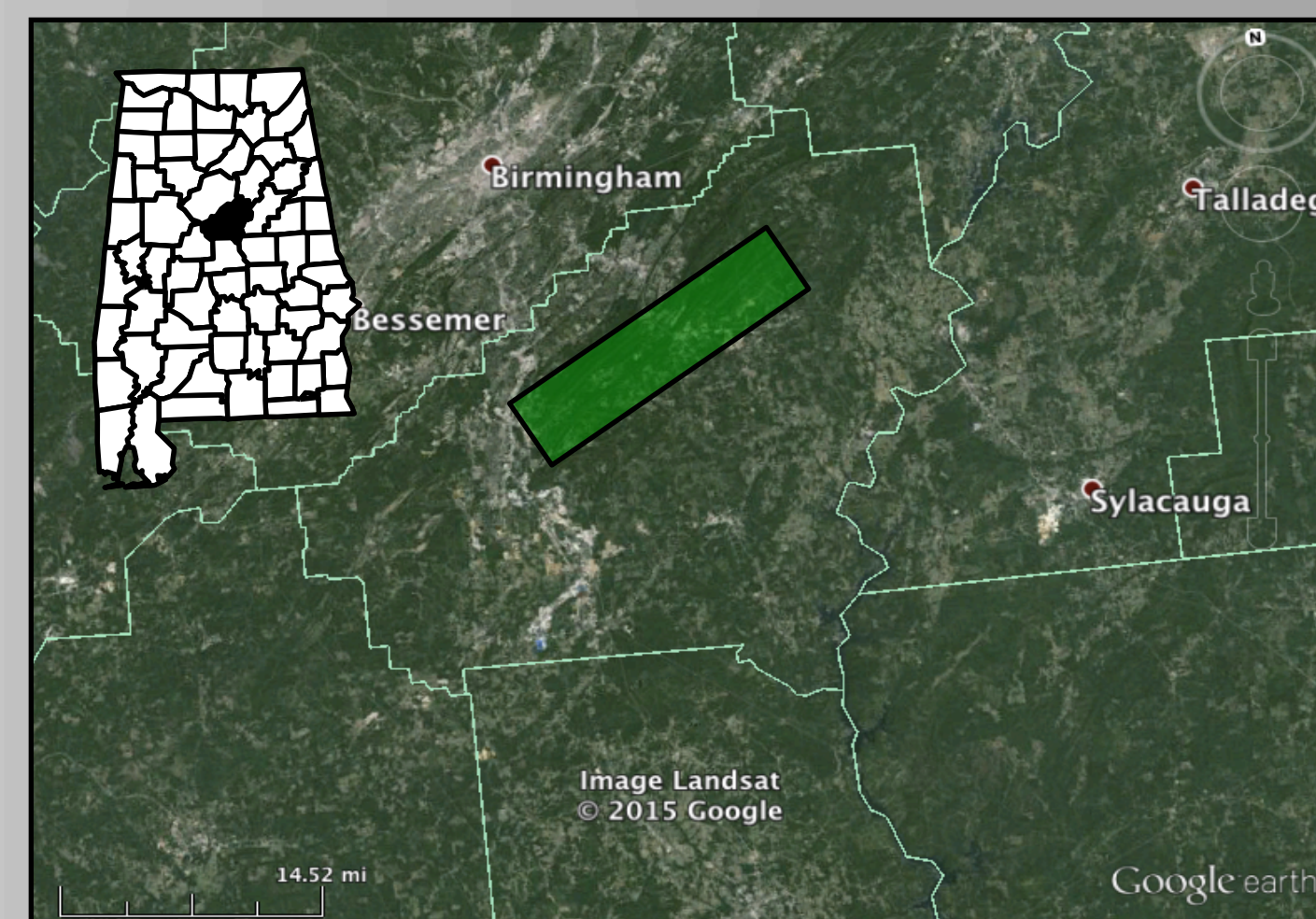
- Once the dominant ecosystem throughout much of the southeast, longleaf pine forests have declined to roughly 3% of their former extent, due to nearly a century of fire suppression, land use changes, and timber harvest (Abrams, 1992).
- Buildup of leaf litter inhibits longleaf pine seedling establishment and causes subsequent burns to be uncontrollably hot and potentially damage even the fire tolerant members of the community (Garren, 1943).
- Frequent prescribed burns have been used successfully to restore longleaf communities that have been degraded by fire suppression (Beckage and Stout, 2000).
- Ground hunting spiders are potential indicators of community response to restoration measures because they are sensitive to understory changes, have a unique position in the food chain, and are easy to collect and observe (Wheater et al., 2000).
- Spider responses to restoration may include changes in density and changes in fitness, as the understory environment changes. Greater weight in spiders is positively correlated with fitness (Nicholas et al., 2011).
- Hypothesis: *Ctenus hibernalis* populations in the region burned five years prior will be more dense, and weigh more than in the fire suppressed region and the region burned one year prior.

Methods

- Sampling sites included three 100m² quadrats in three treatment zones—burned one year prior, burned five years prior, and fire suppressed for the past two decades—of similar slope aspect and altitude
- Adult *C. hibernalis* were collected at night along with environmental data such as leaf litter depth, and canopy cover as well as weather data from the National Weather Service such as humidity, wind speed, cloud cover, moon phase, recent rainfall, and temperature.
- ANOVA and t-tests were used to compare population density values and body weight among treatment sites.
- Multiple regression models were developed using AIC scores to examine relationships among population density, weather data, and environmental data.
- All statistical analyses were run using R v3.1.1 (2014).

Abstract

Fire suppression has greatly impacted the forest ecosystems of the southeastern United States. Fire-suppressed remnant longleaf pine forests in Oak Mountain State Park (OMSP; Pelham, AL) have undergone experimental prescribed burning as a means to restore the understory and overstory structure of a healthy montane longleaf pine forest. We studied the populations of a species of ground hunting spider *Ctenus hibernalis* as an indicator of understory arthropod response to prescribed burning. Study sites included regions burned one year prior to the study, five years prior, as well as a region that has experienced long-term fire suppression. No individuals of *C. hibernalis* were found in the region burned one year prior. Overall, there was no significant difference in the total number of spiders in the fire-suppressed region and the region burned five years ago, but there was a significant difference in the weights of the two populations. Our results suggest that the prescribed burning is beneficial to *C. hibernalis* populations and positively affects their overall fitness levels.



Map 1 Site locations of our treatment regions (33°19'26.78"N, 86°45'27.11"W).



Adult *Ctenus hibernalis*

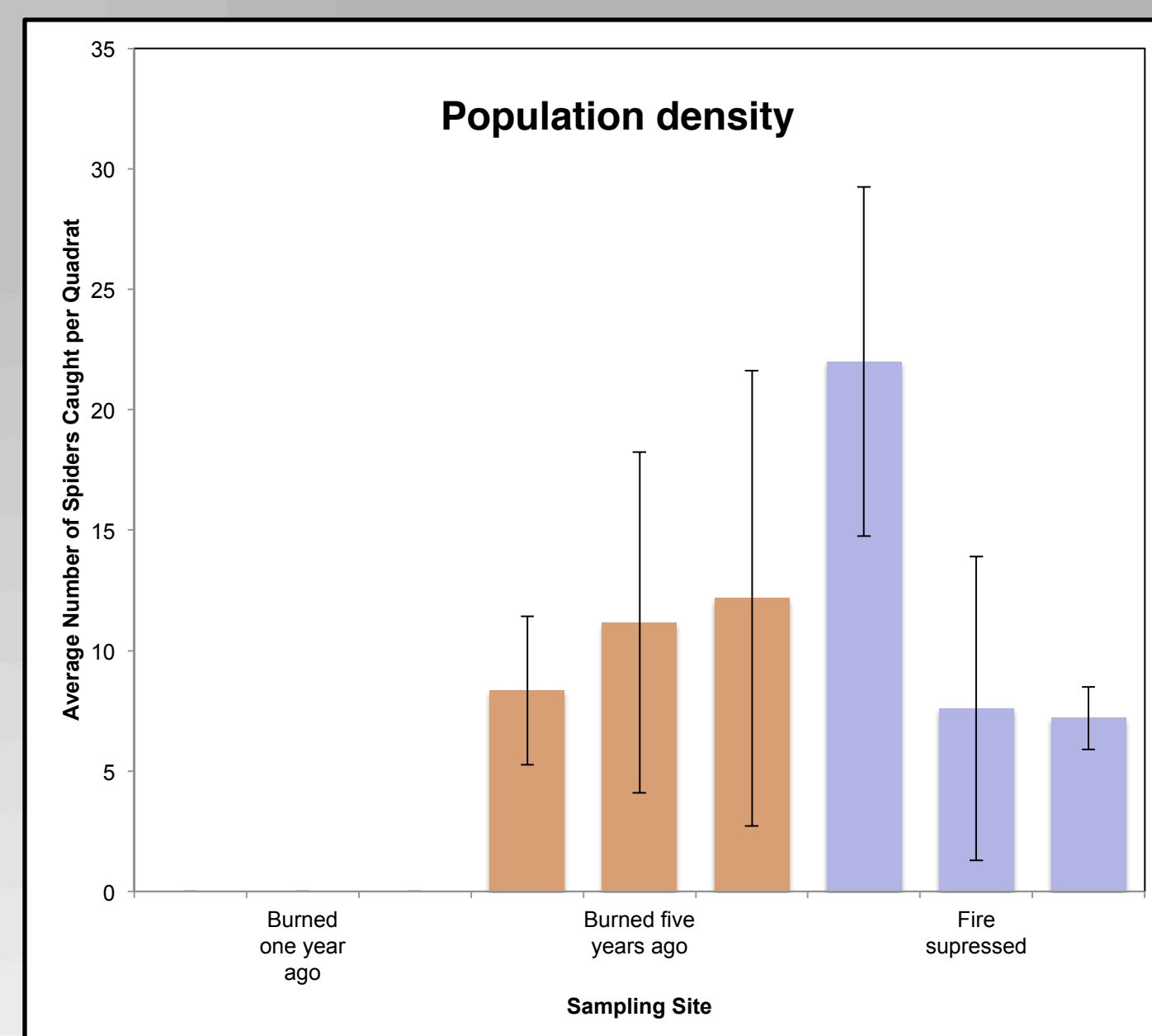


Figure 1. Average individual *C. Hibernalis* caught in per quadrat within our three treatment regions. Error bars indicate standard deviation.

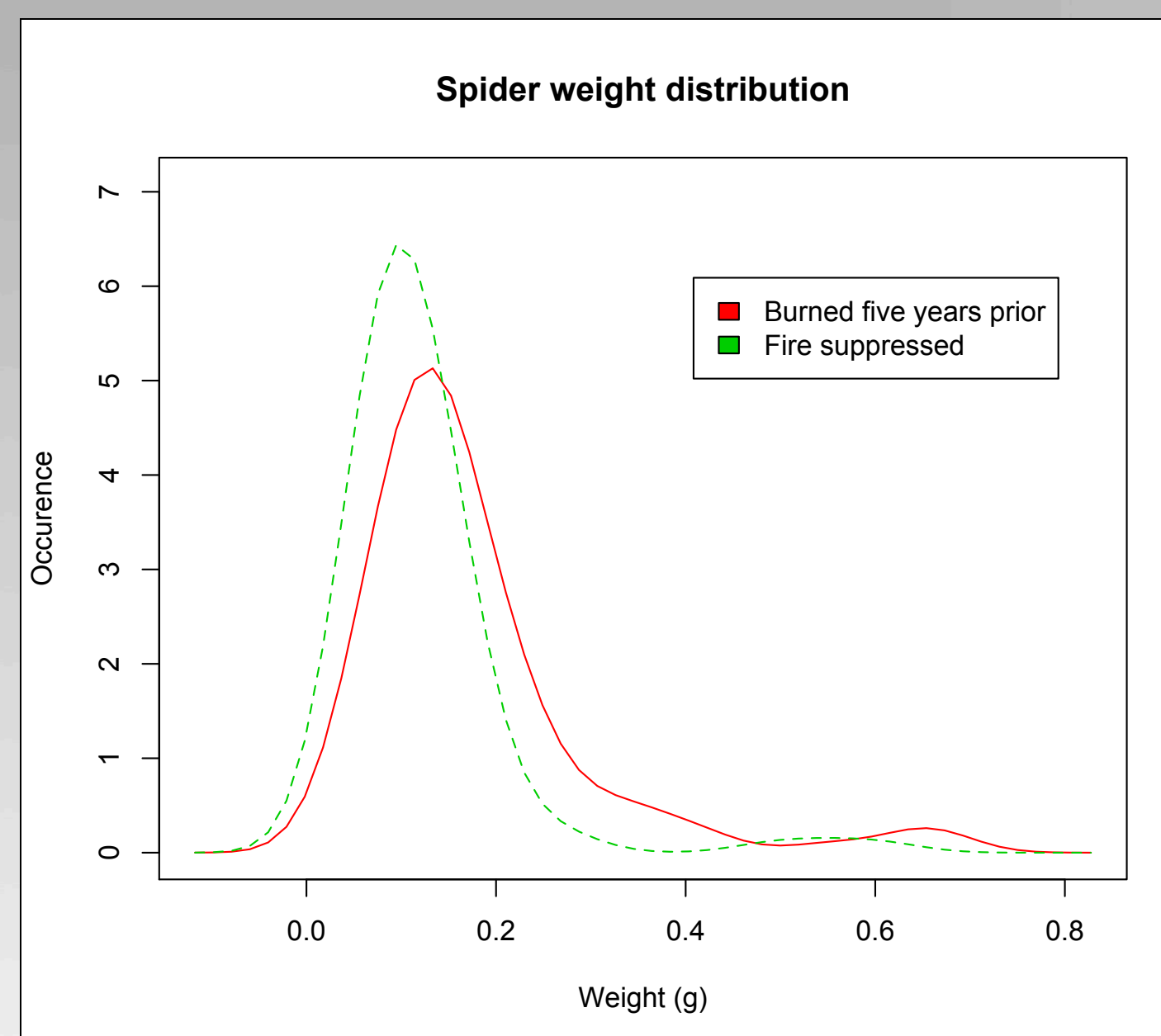


Figure 2 Weight distribution of individuals in fire suppressed regions and regions burned five years prior

Results

- The region burned last year contained zero *C. hibernalis*
- We collected 315 individuals during the duration of our study.
- There was no difference ($t = -0.071$, $df = 25.64$, $p = 0.944$) between the population densities in the fire suppressed region and the region burned five years ago (Fig. 1).
- The weights of the spiders caught in the region burned five years ago were significantly greater than in the fire suppressed region ($t = 3.4715$, $df = 197.047$, $p < 0.001$) (Fig. 2).
- None of the multiple regression models showed significant relationships among population density, weather data, and environmental data.

Discussion

- Although very recent prescribed burning appears to temporarily eliminate *Ctenus hibernalis* populations, the density of this species recovers within 5 years after a burn.
- Differences in weight between burn treatments suggests than an intermediate stage of succession yields spiders with greatest fitness, as measured by weight.
- Prescribed burns have had a measurable effect on individual *C. hibernalis* fitness, potentially because increased light availability in the understory after a burn ultimately increases resource availability for understory arthropod predators.

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