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Appendix 1

Methods

Collection and analysis of vegetation data

Ground cover and understory

In 2010, four 5-m quadrats were established in designated locations of each 25-m block. Within each 5-m quadrat, the percent ground cover was visually estimated for the following variables: vegetation, bare ground, leaf litter and fallen debris. Within the same 5 m quadrat, the percent cover of all understory vegetation (height 0.5–1.5 m) was visually estimated by species and type (i.e. tree, shrub, vine, herbaceous and debris), with debris including dead vegetation. In 1995, all 25 5-m quadrats were sampled. To compare datasets, four quadrats were randomly subsampled from 1995 datasets. The average percent cover for each parameter was compared between 1995 and 2010 at the site level.

Woody species stem tally by species and diameter class

For each 25 m block, all live and dead stems were tallied by diameter class for woody tree, shrub and vine species with heights of 1.5 m or higher. The diameter size class categories in cm are as follows: 0–5, 5.1–20, 20.1–45, 45.1–60 and >60. The average number of both live and dead tree, shrub, and vine stems was compared between 1995 and 2010 at the site level, as was also done for the five tree species listed above.

Collection and analysis of arthropod data

Arthropod sampling was conducted approximately weekly during each spring migration season since 2005, during the same timeframe as the bird banding effort (28 March to 6 May) to estimate the abundance of food available to migrants throughout migration (Fig. 3). Samples were identified from branch clippings (Cooper and Whitmore 1990) taken from randomly selected southern hackberry, live oak and honeylocust located near five different permanently established sampling locations spaced 50 m apart. Branches were clipped into plastic garbage bags and insecticide was sprayed inside the bag before quickly tying the bag closed. Soon after, arthropods were identified to order with each length estimated to the nearest centimeter. After air drying, each branch was weighed to the nearest 0.5 g with a spring scale. A length-mass regression equation that is commonly used for North American arthropods was used to estimate arthropod mass from length (Rogers et al. 1976). Arthropod mass estimates were then summed to obtain the total estimated arthropod biomass for each branch clipping, giving an estimate of total arthropod biomass per gram of vegetation. For southern hackberry, the total number of branch samples per treatment was 27 for pre-storm, 35 for post-Rita, and 15 for post-Ike. For live oak there were 25 for pre-storm, 35 for post-Rita, and 15 for post-Ike. For honeylocust, there were 16 pre-storm, 35 post-Rita, and 15 post-Ike. Because we only have a single year of pre-storm data, we present arthropod abundance data as an anecdotal measure of resource availability. Results of arthropod sampling are reported descriptively.

Migrant abundance

In order to select species for analyses, we used a modified capture criteria similar to that used by Paxton et al. (2014) and Cohen et al. (2015). The criterion used for the abundance analysis was to select species that had either a mean pre- (1993–1996 and 1998–2005) or post-storm (2006–2011) capture total of at least 10 different individuals (Table 1). The purpose was to detect a response to changes in habitat quality of sufficient magnitude to examine statistically. Some species with low capture rates prior to the storms were analyzed to see if their capture numbers had changed after the storms. Mist net capture data were used to examine the initial impacts of each hurricane, Rita and Ike, on migrant abundance by species during the first spring migration after each storm (2006 and 2009) compared to a pre-storm mean.

After testing the pre-storm capture data for normality using a Shapiro–Wilk test on each species distribution ($n = 32$), we then performed log ($n = 1$) and square root ($n = 10$) transformations on the species that did not meet normality. One distribution, that of the blue grosbeak *Passerina caerulea*, did not meet normality after transformation.

Migrant stopover duration

After testing the pre-storm data for normality using a Shapiro–Wilk test on each species distribution ($n = 15$), we then performed log transformation ($n = 1$) on the red-eyed vireo *Vireo olivaceus* distribution since it did not meet normality. The distributions of two species, rose-breasted grosbeak

Pheucticus ludovicianus and summer tanager *Piranga rubra*, were not normally distributed, even after attempting all typical transformations; these data were subsequently analyzed using a one-sample sign test (Conover 1999).

Migrant fuel deposition rates

Using the same subset of data as described in the 'Migrant stopover duration' section above, the criterion for the fuel deposition rate analysis was that a species had at least five individuals recaptured each season for five out of the twelve pre-storm years (Table 1).

Results

Vegetation

Vegetation layers

The largest change in the ground layer was in the coverage of fallen debris, which increased significantly from 7.75% (± 3.32) pre-storm to 31.67% (± 10.13) post-storm ($t = –11.34$, $p < 0.01$. adjusted $\alpha = 0.01$). There was significantly less ground level vegetation after both hurricanes (pre-storm: 59.04 ± 19.48%; post-storm: 48.75 ± 7.65%; $t = 2.59$, $p = 0.02$, adjusted $\alpha = 0.02$). While the percent cover of both leaf litter and bare ground decreased after the hurricanes from 48.13 ± 18.14% and 15.34 ± 9.69% to 43.75 ± 21.77% and 12.03 ± 5.86% respectively, these changes were not significant ($p > 0.20$). Another significant change was in the percent cover of all understory variables after the hurricanes. Although there were significantly fewer vines, which changed from 0.34 ± 0.28% to 0.15 ± 0.17% pre- and post-storm ($t = 2.98$,p*p* < 0.01, adjusted $\alpha = 0.03$), all other understory variables showed a significant increase. The amount of dead vegetation exhibited the largest increase, from 0.01 ± 0.03% pre-storm to 2.45 ± 2.61% post-storm ($t = –10.00$, $p < 0.01$, adjusted $\alpha = 0.01$). Herbaceous species also showed a significantly large increase (0.48 ± 0.32% to 2.14 ± 1.46%, $t = –5.37$, $p < 0.01$, adjusted $\alpha = 0.02$) as did woody species in the understory (0.25 ± 0.18% to 0.47 ± 0.34%, $t = –2.83$, $p < 0.01$, adjusted $\alpha = 0.05$).

The changes in woody species between pre-storm and post-storm measures were variable for overall vines and trees/shrubs, as well as particular tree species. Live vines less than or equal to 5 cm significantly decreased after the storms from 969.5 ± 596.55 to 15.83 ± 10.84 stems ($t = 20.84$, $p < 0.01$, adjusted $\alpha = 0.01$). Both live and dead vines in the 5–20 cm size class showed significant differences after impact from the hurricanes; live vines decreased from 5.21 ± 4.56 to 0.21 ± 0.51 stems ($t = 7.49$, $p < 0.01$, adjusted $\alpha = 0.02$) whereas dead vines increased from 0.04 ± 0.20 to 6.17 ± 5.78 stems ($t = –10.27$, $p < 0.01$, adjusted $\alpha = 0.01$). Dead vines in the smallest class (≤ 5 cm) and live vines in the largest size class (> 60 cm) were not significantly different between the two surveys. The only tree/shrub category to have a significant effect were dead trees/shrubs in the 20-45 cm size class, increasing from 0.25 ± 0.44 stems pre-storm to 2.88 ± 2.36 stems post-storm ($t = -7.84$, $p < 0.01$, adjusted $\alpha = 0.01$). Trees and shrubs in the following categories were not significantly different between surveys ($p > 0.04$, adjusted $\alpha = 0.01$): live trees/shrubs in the 20–45 cm, 45–60 cm, and > 60 cm size classes in addition to dead trees/shrubs in the 45–60 cm and > 60 cm size classes.

The only tree species to have a significant change after the hurricanes were certain categories within southern hackberry, honeylocust and Chinese tallow; live oak and mulberry showed no difference between the two surveys. The following size classes of live southern hackberry significantly decreased after the hurricanes: 5 cm and under from 49.71 ± 44.94 to 4.33 ± 5.75 stems ($t = 10.25$, $p < 0.01$, adjusted $\alpha = 0.01$), 5-20 cm from 21.00 ± 10.57 to 6.54 ± 6.25 stems ($t = 8.12$, $p < 0.01$, adjusted $\alpha = 0.01$), and 20-45 from 2.96 ± 2.01 to 0.67 ± 1.37 stems ($t = 3.98$, $p < 0.01$, adjusted $\alpha = 0.01$). The following size classes of dead southern hackberry significantly increased between surveys: 5–20 cm from 1.38 ± 1.61 to 5.58 ± 4.84 stems ($t = -3.94$, $p < 0.01$, adjusted $\alpha = 0.01$) and 20–45 cm from 0.13 ± 0.34 to 1.21 ± 1.14 stems ($V = 0$, $p < 0.01$, adjusted $\alpha = 0.01$). Honeylocust significantly increased in both the number of dead stems in size class 5–20 cm from 0.00 ± 0.00 to 2.83 ± 4.35 ($V = 0$, $p < 0.01$, adjusted $\alpha = 0.01$) and the number of live stems in the 20–45 cm size class from 0.21 ± 0.51 to 1.08 ± 1.44 ($V = 7$, $p < 0.01$, adjusted $\alpha = 0.01$). Finally, Chinese tallow significantly decreased in the number of live stems under 5 cm from 9.54 ± 20.06 to 0.58 ± 0.93 ($V = 178$, $p < 0.01$, adjusted $\alpha = 0.01$) and significantly increased the number of dead stems in the 5–20 cm size class from 0.00 ± 0.00 to 0.71 ± 1.20 ($V = 0$, $p < 0.01$, adjusted $\alpha = 0.01$).

Arthropods

Arthropod abundance was lower in 2006 after Rita compared to 2005 numbers for honeylocust (2005: 0.02 ± 0.02 g; 2006: 0.002 ± 0.004 g) and live oak (2005: 0.002 ± 0.003 g; 2006: 0.0008 ± 0.001 g), but similar post-Rita compared to 2005 for southern hackberry (2005: 0.002 ± 0.003 g; 2006:0.002 ± 0.007 g). Arthropod abundance was lowest in 2009 after Ike compared to 2005 and 2006 for all species (southern hackberry: 0.0003 ± 0.0004 g; honeylocust: 0.0001 ± 0.0002 g; live oak: 0.0002 ± 0.0004 g).

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