Impacts of Fire and Flooding Events on Insects in the Big Thicket National Preserve, Texas

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Abstract

Collections of selected orthopteroids, neuropterans, coleopterans and hymenopterans were made before and after flood and fire disturbances in the Big Thicket National Preserve, Texas in 2017–2019. Comparisons of samples suggest that different insect groups vary in their responses to disturbance. Antlions decreased in number substantially after flooding, but grasshoppers and select beetle families did not. After a prescribed burn, the wasp genus *Pluto* increased significantly, but grasshoppers and mantises did not. Possible explanations for observed results are discussed.

Introduction

The Big Thicket region of southeastern Texas is known to harbor a diverse biota and a large number of distinct habitats[1, 2]. In 2017, surveys of various insect groups within the Big Thicket National Preserve were initiated at several sites. In late August of that year, the project was interrupted by Hurricane Harvey. One of the survey sites, a xeric, open grassland within a longleaf pine forest, was substantially inundated by floodwaters of a nearby creek (referred to hereafter as "dry grassland") as a result of the storm. This site was resampled in 2019.

A second site, a wet grassland characterized by waterlogged soils, was surveyed in 2017 and 2019 (referred to hereafter as "wet grassland"). In 2018, this site was subjected to a prescribed fire to promote grass and inhibit shrubby vegetation.

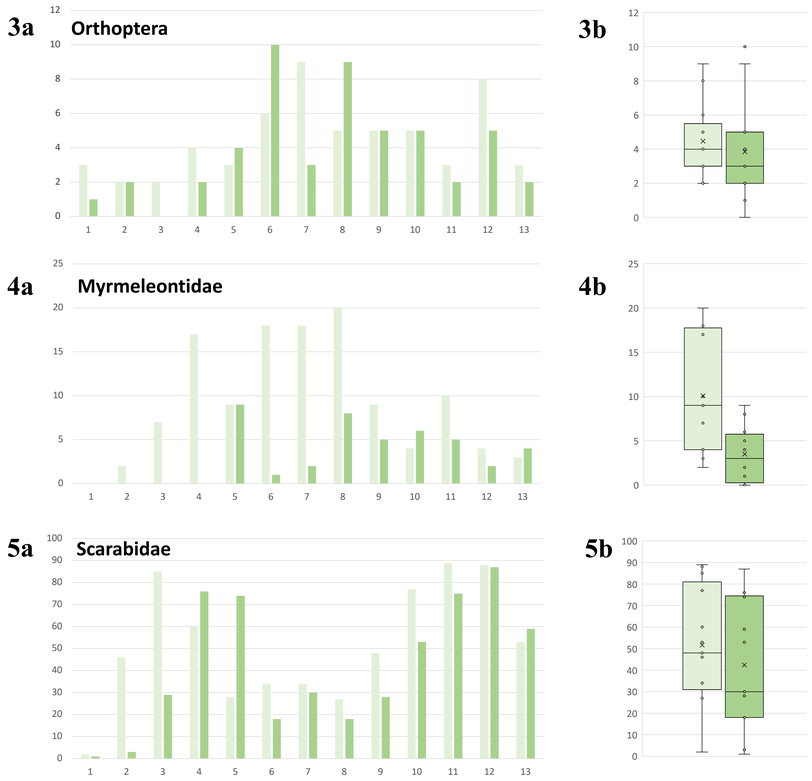
Herein, we report results from these surveys in an effort to determine the impacts of both flood and fire on select groups of insects including Orthoptera (grasshoppers, katydids, and crickets), Myrmeleontidae (antlions), Scarabidae (scarab beetles), Cerambycidae (long-horned beetles), and one group of crabronid wasps (*Pluto* sp.).

Figure 1. Location of field sites in Hardin County, Texas.

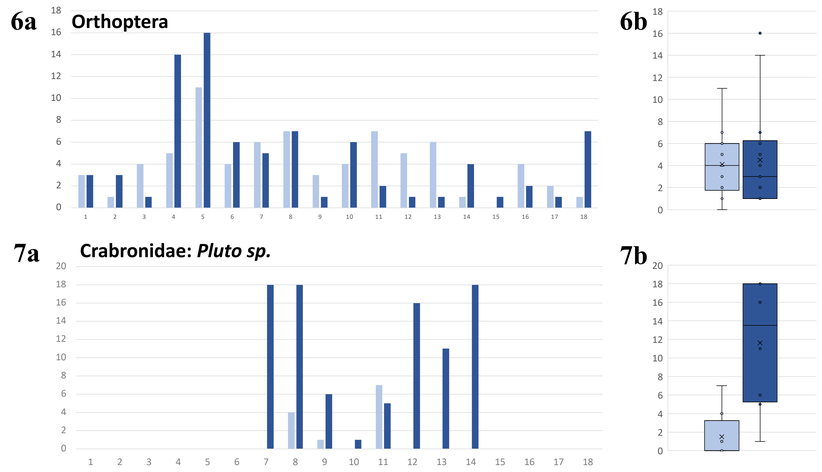
Figure 2. Malaise trap.

Methods and Materials

Survey sites were established in the Turkey Creek Unit of the Big Thicket National Preserve (Hardin Co.; Fig. 1). A variety of methods were used including multiple kinds of traps and capture with a butterfly net. In order to standardize effort across compared samples, results presented here are limited to insects captured by Malaise traps (Fig. 2). One trap sampled insects continuously at each site and was serviced every two weeks. These intervals correspond to numbered sampling "rounds" in the analysis. The dry grassland Malaise trap ran from late February to late August 2017 and from late February to early November 2019. At the wet grassland site, a trap ran from late February to early November in 2017 and 2019. Trapped insects were processed, identified, and archived in the SFA Department of Biology. Bar graphs were generated to show seasonal variation. Mean and median values of insects collected per round were compared with boxplots, and two-sample t-tests were employed to detect significant differences.



Figures 3–5: (A) Number of insects collected vs. round (two-week samples made from late February ["round 1"] to late August ["round 13"]) at a site before (2017, light green) and after (2019, dark green) a flooding event at a dry grassland site in the Big Thicket National Preserve, Texas. (B) Box plots showing mean (x) and median values of insects collected per round.



Figures 6–7: (A) Number of insects collected vs. round (two-week samples made from late February ["round 1"] to early November ["round 18"]) at a site before (2017, light blue) and after (2019, dark blue) a prescribed fire at a wet grassland site in the Big Thicket National Preserve, Texas. (B) Box plots showing mean (x) and median values of insects collected per round.

Results and Discussion

At the dry grassland site, the site subjected to floodwaters, Orthoptera (Fig. 3) and two groups of beetles, Scarabidae (Fig. 5) and Cerambycidae (not figured), did not show a significant change across years. On the other hand, Myrmeleontidae showed a significant decline (Fig. 4) ($t[16] = 4.0$, $p = 0.001$). Given that the latter make conical pits in sand as larvae, they may have been decimated by floodwaters. However, scarab beetles mainly occur underground as larvae; it is surprising that they did not show a similar decline. If they were mostly in the pupal stage at the time of the flood, they may have been afforded some degree of protection. Orthoptera juveniles and adults may have been able to survive by climbing vegetation.

At the wet grassland site, the site subjected to prescribed fire, Orthoptera (Fig. 6) and Mantodea (not figured) showed little change across years. It is likely that these insects would have succumbed to the fire, yet the populations either rebounded or were never substantially impacted. One group of crabronid wasps, a species in the genus *Pluto*, showed a pronounced increase (Fig. 7) ($t[9] = -3.9$, $p = 0.004$). If this change is related to the burn, it may be due to an increase in its prey, a grass feeding leafhopper. The change in leafhopper abundance has yet to be quantified, but a subjective evaluation suggests that it greatly increased in 2019, likely as a result of the proliferation of grass, the intended result of the burning event.

As has been found in other studies[3, 4], this work suggests that the responses of insects to ecological disturbance are varied and complex.

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