LONGHORNED BEETLES IN GREENTREE RESERVOIRS AND NATURALLY FLOODED BOTTOMLAND HARDWOOD STANDS

Michael D. Warriner, T. Evan Nebeker, and Steven A. Tucker[1]

Abstract—Greentree reservoirs are bottomland hardwood forests that are artificially flooded during fall/winter to provide habitat and food for wintering waterfowl. Research has indicated that this practice could negatively impact bottomland hardwood stands leading to decreases in mast production, tree vigor and growth, and regeneration. Outside of waterfowl and aquatic macroinvertebrates, little research has been conducted regarding the effects this management practice has on other faunal elements. In this study, we examined longhorned beetle diversity and abundance in greentree reservoirs and naturally-flooded bottomland hardwood stands in Mississippi. Longhorned beetle species composition and levels of abundance were similar among greentree reservoir and naturally-flooded stands. Examination of species assemblages collected from greentree reservoirs did not reveal the presence of large numbers of longhorned beetles known to attack healthy and/or stressed trees. The largest number of species and individuals collected from all study sites were ones with associations with dead woody material.

INTRODUCTION

Greentree reservoirs are bottomland hardwood forests that have been impounded with levees and are temporarily flooded during fall and winter to provide food and habitat for wintering waterfowl (Rudolph and Hunter 1964). Research has suggested that this practice can negatively impact bottomland hardwood stands, leading to decreases in mast production (Francis 1983), tree vigor and growth (King 1995, Schlaegel 1984), and regeneration (Young and others 1995). There is also evidence that the artificial flooding regimes applied to greentree reservoirs can shift tree species composition towards more flood tolerant species (Karr and others 1990, King 1995). Problems associated with these sites can often be tied to inundation that extends into the growing season (Wigley and Filer 1989), reducing soil aeration, killing less water-tolerant tree species, and increasing overstory mortality (King and Allen 1996).

Although a body of knowledge exists regarding the impacts of greentree reservoir management on bottomland hardwood vegetation, little attention has been paid to faunal communities in these settings (King and Allen 1996). Faunal studies conducted thus far have generally been confined to waterfowl (Allen 1980, Arner and others 1974) and aquatic macroinvertebrate communities (Duffy and Labar 1994, Hubert and Krull 1973, Krull 1969, Wehrle and others 1995) with little attention paid to terrestrial animal taxa. What impact this management practice has on various terrestrial faunal groups should also be evaluated.

Though little studied in bottomland hardwood forests, insects have the potential to provide useful information regarding environmental changes (Kremen and others 1993). Insects are a fundamental component of forest ecosystems, performing important ecological roles from pollination, nutrient cycling, to predation (Packham and others 1992). Thus far, most insect-related studies conducted in southern forested wetlands have taken the form of faunal surveys (Allen and Thompson 1977, Goff 1952, Shelford 1954) or examined the influence of natural disturbances on insects and other terrestrial arthropods (Gorham and others 1996, Gorham and others 2002, Uetz and others 1979). Fewer still have investigated the impact of forest management practices on insects in these systems (Thompson and Allen 1993, Warriner and others 2002).

Longhorned beetles (Coleoptera: Cerambycidae) are an entirely phytophagous group of insects composed of species that feed on a range of woody and herbaceous plant species (Linsley 1959). While the adult stage of a number of species do not feed, the larvae of most all species bore within and feed upon plant tissues. Adult longhorned beetles are known to exhibit distinct preferences regarding oviposition sites, specifically as it relates to larval host condition (Hanks 1999). Oviposition preferences can often be very specific and can range from healthy and stressed trees and herbaceous plants to dead and decaying woody material (Yanega 1996). Although some longhorned beetles are recognized as important economic pests due to their wood-boring tendencies (Beal and others 1952, Donley and Acciavatti 1980, Galford 1916, Solomon 1980), most species feed on dead and decaying woody hosts (Yanega 1996), playing vital roles in the initial fragmentation and breakdown of dead wood in forest ecosystems (Harmon and others 1986).

Information regarding larval host preference is available for a large number of longhorned beetle species (Craighead 1923, Hanks 1999, Hanula 1996, Solomon 1995, Yanega 1996). Due to their close ties to both living trees and dead woody material, longhorned beetles could provide useful information about the forests in which they occur (Yanega 1996). Our objective in this study was to ascertain what

[1] Field Ecologist, Arkansas Natural Heritage Commission, 1500 Tower Building, 323 Center Street, Little Rock, AR 72201; Professor, Department of Entomology and Plant Pathology, Box 9775, Mississippi State University, Mississippi State, MS 39762; and Animal Care Coordinator, Department of Wildlife and Fisheries, Box 9690, Mississippi State University, Mississippi State, MS 39762, respectively.

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impact greentree reservoir management has on longhorned beetle diversity and abundance. In particular, we wanted to assess whether artificial flooding regimes influenced the representation of longhorned beetle species within certain larval host preference groups.

STUDY SITES

This study was conducted at Noxubee National Wildlife Refuge in east-central Mississippi during the summer of 2000. Approximately 5,300 ha of the refuge are comprised of bottomland hardwood forests (Duffy and LaBar 1994). Study sites consisted of two greentree reservoirs and two unimpounded bottomland hardwood stands. Greentree reservoirs were approximately 240 ha and 220 ha in size. Both greentree reservoirs had been artificially flooded on a nearly annual basis since the mid to late 1950's (Young and others 1995). The two sites were typically inundated, with water from a nearby lake, starting in late November or early December with drawdown by late February to early March (Wehrle and others 1995).

Two unimpounded bottomland hardwood stands, exposed to natural flood patterns, served as controls. The two stands were approximately 100 ha and 80 ha in size. Composition of dominant tree species within greentree reservoirs and naturally flooded study sites was relatively similar, although overcup oak (*Quercus lyrata* Walt.) was more common within the two greentree reservoir sites. Along with overcup oak, dominant tree species included water oak (*Q. nigra* L.), willow oak (*Q. phellos* L.), cherrybark oak (*Q. pagoda* Raf.), American sweetgum (*Liquidambar styraciflua* L.), and red maple (*Acer rubrum* L.).

METHODS

Insect Sampling Procedures

Longhorned beetles were sampled using Malaise traps and window traps. Malaise traps are large tent-like structures that passively trap low-flying insects and collect them in a container filled with a preservative/killing agent (Townes 1972). Samples of Malaise trapped beetles have been shown to be characteristic of recognizable communities and strongly related to habitat variables up to 50 m from traps (Hutcheson 1990; Hutcheson and Jones 1999). Collecting containers were filled with 70 percent ethanol. Two Malaise traps were placed in each greentree reservoir and naturally flooded stand. Traps within a single stand were at least 50 m from the nearest road and 150 m apart. Window traps (flight-intercept trap) were also deployed at each study site. Window traps, modified from Økland (1996), consisted of two perpendicular clear plastic sheets (35 cm x 40 cm) attached to a collecting container (33 cm diameter). Collecting containers were filled with propylene glycol. A roof was placed on top of the intersecting clear plastic sheets to prevent rainfall from flooding the collecting container. Window traps were hung between two trees at a height of 2 m. A total of six traps, spaced 20 m apart, were placed at each study site. All traps were operated continuously, from mid April to late October 2000. Traps were serviced, and collected insects removed every two to three weeks. Collected longhorned beetles were sorted, stored in 70-percent ethanol, and identified to species. Larval host preferences for collected species were determined from Craighead (1923), Hanks (1999), Hanula (1996), Solomon (1995), and Yanega (1996). Based upon those preferences, species were assigned to one of four host groups. Larval host groups, modified from Hanks (1999), were as follows:

1. healthy hosts-species feeding on healthy woody plants
2. weakened/stressed hosts–species feeding on woody plants weakened by disease, injuries, or other causes
3. dead/decaying hosts–species feeding on downed or standing dead trees and branches in various stages of decay
4. unknown hosts–species for which larval host preference is unknown.

Data Analysis

Similarities in longhorned beetle species composition among greentree reservoirs and naturally-flooded stands were assessed using the Morisita-Horn index (Wolda 1981). This index produces a value of one when two samples possess identical faunas and a value of zero for two samples with completely different faunas. The Morisita-Horn index is based upon abundance data, rather than binary data, and therefore performs more effectively than some qualitative indices (Magurran, 1988). The index is also less dependent upon sample size and diversity than other quantitative indices (Wolda 1981). Distribution of number of species and individuals (pooled data) belonging to specific larval host preference groups were compared between greentree reservoirs and naturally-flooded stands using a Chi-square test.

RESULTS AND DISCUSSION

A total of 829 longhorned beetles representing 49 species were collected from the greentree reservoirs. In the naturally-flooded stands, 930 individuals comprising 47 species were trapped. Faunal similarities among greentree reservoirs and naturally-flooded stands, as expressed by the Morisita-Horn index, were high (> 0.80) indicating few differences in species composition among the four individual study sites (table 1).

The majority of longhorned beetles trapped were species with oviposition preferences for woody plants (deciduous trees and shrubs). Within this wood-feeding group, the largest number of species and individuals were characterized by associations with dead woody material (table 2). Species feeding on weakened/stressed hosts made up a

Table 1—Comparison of longhorned Beetle faunas (Morisita-Horn) collected from greentree reservoir and naturally flooded bottomland hardwood forest study sites

	NFBH 2	GTR 1	GTR 2
NFBH 1	0.92	0.83	0.82
NFBH 2	0.84	0.82	
GTR 1			0.87

NFBH = naturally flooded bottomland hardwood; GTR = greentree reservoir.

Table 2—Number of longhorned beetle species and individuals by larval host preference in greentree reservoir and naturally flooded bottomland hardwood forest study sites

	GTR		NFBH	
Larval host preference	Species	Individuals	Species	Individuals
Healthy host	3	36	4	35
Weakened and stressed hosts	9	61	7	82
Dead and decaying hosts	30	623	28	716
Unknown hosts	7	109	9	96

GTR = greentree reservoir; NFBH = naturally flooded bottomland hardwood.

smaller portion of the species collected. Even fewer trapped beetles belonged to species known to feed only on healthy hosts. Numbers of species within each larval host preference group did not differ between greentree reservoirs and naturally flooded stands ($\chi^2 = 0.84$; df = 3; $P = 0.8399$). Numbers of individuals within each group also did not differ ($\chi^2 = 4.71$; df = 3; $P = 0.1943$).

As mentioned above, the most frequently collected longhorned beetles from both greentree reservoirs and naturally-flooded stands were those associated with dead wood. Of these, *Elaphidion mucronatum* (Say) (dead branches), *Curius dentatus* Newman (dead branches), *Neoclytus mucronatus* (Fabricius) (under bark of recently dead trees), *Orthosoma brunneum* (Forster) (well-decayed, moist wood), and *Strangalia luteicornis* (Fabricius) (well-decayed, moist wood) were the most abundant. Additional dead-wood feeding species included *Distenia undata* (Fabricius) (roots of recently dead trees), *Ecyrus dasycerus* (Say) (dry dead wood), *Saperda lateralis* Fabricius (moist dead wood at base of trees), and *Typocerus acuticauda* Casey (moist, decaying wood). Species with preferences for healthy hosts were collected in smaller numbers and consisted of a few twig-girdling species such as *Anelaphus villosus* (Fabricius), *Doraschema alternatum* (Say), *Goes debilis* LeConte, and *Obera praelonga* Casey as well as the root-feeding (oaks) *Prionus imbricornis* (Linnaeus). Longhorned beetles associated with weakened/stressed hosts included *Hyperplatys aspersa* (Say) and *N. acuminatus* (Fabricius). The remaining group of longhorned beetles included a number of species whose host plants have yet to be identified.

Based upon our limited data, greentree reservoir management did not appear to represent a suppressor to longhorned beetle diversity or abundance. Most of the longhorned beetle species collected from naturally-flooded stands were also present in the greentree reservoirs. Abundances of species shared between greentree reservoirs and naturally-flooded stands also did not differ greatly. In addition, representation among larval host preference groups did not differ, possibly indicating the availability of similar levels of host resources (dead wood, weakened trees) in both settings.

As a group, longhorned beetles are probably little affected by flooding that does not extend into the growing season. Flooding in bottomland hardwood forests typically occurs during the winter to early spring, a time when the larvae of most longhorned beetles are still within the woody confines of their hosts. However, if flooding extended well into the growing season when some species emerge from their hosts, mortality could occur, particularly in those species associated with downed wood on the forest floor.

Many of the problems associated with greentree reservoir management such as shifts in tree species composition, reduced mast production, and tree mortality often result when water is impounded into the growing season. It has been estimated that less than 20 percent of greentree reservoir managers remove impounded water by their target date (Wigley and Filer 1989). Managers at Noxubee National Wildlife Refuge generally remove water from their greentree reservoir by January to early February, well before spring. Greentree reservoirs managed less stringently than those examined by this study should be examined to determine whether flooding into the growing season impacts the longhorned beetle fauna within those forests.

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