Post Hurricane Black Turpentine Beetle Damage

Richard Johnson II

DISSERTATION.COM

Boca Raton

Post Hurricane Black Turpentine Beetle Damage

Dissertation.com
Boca Raton, Florida
USA • 2007

ISBN-10: 1-58112- 391-4
ISBN-13: 978-1-58112-391-3

December, 2007

Lake Charles, Louisiana

POST HURRICANE BLACK TURPENTINE BEETLE DAMAGE

By:

Richard D Johnson II

A Thesis

Submitted to the Graduate Faculty of
McNeese State University
in Partial Fulfillment of
the Requirements for the Degree

MASTER OF SCIENCE IN CHEMICAL AND ENVIRONMENTAL SCIENCES
CONCENTRATION IN AGRICULTURAL SCIENCE

Billy DeLany Assistant Professor of Agriculture	Frederick LeMieux Associate Professor of Agriculture, Dept head
Edward Ferguson Assistant Professor of Agriculture	Frank Phillips Assistant Professor of Environmental Science

George F. Mead, Dean
Dore School of Graduate Studies

ACKNOWLEDGMENTS

I would like to especially thank Billy DeLany, Ph.D. and Chip LeMieux, Ph.D. for guidance and support throughout this study. Through the funding and support of the Frank Pruitt Foundation, this project has been a success. This study would not have been possible without the support of the faculty and staff of the Harold and Pearl Dripps Department of Agriculture Sciences. Thank you to all of my dedicated committee members (Billy DeLany, Edward Ferguson, Chip LeMieux, and Frank Phillips) for your patience and guidance through the completion of this study. I would like to thank my parents, Richard and Debra Johnson, for providing support in all of my endeavors and to my grandmothers: Mary Jane Cox, Dorothy Vines, and Unnie V. Cudd for always being there for the family. I also want to thank my sisters: Summer Bartley, Theresa Primeaux, and Cindy Middleton, for inspiring me to continue in my educational pursuits. Ultimately, I would like to express many thanks to the countless hours spent by my mentors and friends who have consulted me throughout my life and education.

ABSTRACT

Johnson, Richard D., B.S., McNeese State University, 2003.
Master of Science, Fall 2007.
Title of Thesis- Post Hurricane Black Turpentine Beetle Damage.
Thesis directed by: F. M. LeMieux, Ph.D. and Billy Delany, Ph.D.

The Louisiana timber industry relies on the availability of harvestable trees. In areas affected by Hurricanes Katrina and Rita, the black turpentine beetle (*Dendroctonus terebrans*) contributed to the mortality of loblolly (*Pinus taeda*) and slash *(Pinus elliottii)* pine trees. This timber loss due to natural causes reduces the landowner's earnings The BTB girdles the cambium layer of pines that are weakened by wind or drought. This study estimated post-Rita beetle damage on a 458-acre slash pine tract consisting of 157 trees per acre on the West Bay Wildlife Management Area, Louisiana. Timber loss was estimated by identifying, mapping, and calculating the board footage of infested trees on 40 randomly selected plots within the sampling area. There were 785 infested trees that averaged 28.3 board feet per tree. The loss totaled to 22,216 board feet with a value of $7,775. The estimated timber loss was compared to historical tree losses due to beetle infestations. Further research should be implemented to gather additional information on timber losses that resulted from the consequential infestation of the black turpentine beetle in hurricane affected timber stands.

Key Words: Black turpentine beetle, Hurricane winds, Slash Pine Timber, West Bay Wildlife Management Area, Trimble

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

The Louisiana pine timber industry relies on the available supply of harvestable trees. Forestry is the number one agricultural commodity in Louisiana, providing 4.9 billion dollars to the state's economy in 2006 (LSUAgcenter, 2007). To maintain this forestry supply, timber lost to natural phenomena needs to be estimated to predict current and future harvest levels. Factors that can affect a pine stand are: drought, fire, wind, floods, disease, and various pest infestations. In 2005, pine stands were affected by Hurricanes Katrina and Rita (hurricane winds and post-hurricane drought), and subsequently black turpentine beetles (*Dendroctonus terebrans*) (BTB). The combined effects of hurricane wind, drought and the BTB were noted throughout the hurricane affected regions of Louisiana (Hurwitz, 2006).

The BTB infests and in combination with other stress factors (bark beetles, fire, and wind damage), kills weakened trees (Baker, 2005). A weakened tree may have had the cambium compromised, phloem damage, other bark beetle attacks, or excessive bark damage. The infestations are noted by the following symptoms: sawdust around the base of the tree, browning of the pine needles, and pitch tubes on the lower portion of the trunk (Merkel, 1981).

Due to the conspicuous nature of BTB infestations, a preventative management system for BTB tree infestations is not present in most forest management systems (Feduccia and Mann, 1975). The BTB attacks pine stands that have already been stressed due to harvesting, disease, other pests or weather; therefore, management of stressed stands may not prove to be beneficial (Smith and Lee, 1972). Although, when a natural perturbation triggers BTB infestations there have been reports of the BTB destroying up to 10 % of a stand (Smith and Lee, 1972). Other pests that infest pine stands are: Southern Pine Beetle (*Dendroctonus frontalis*), and engraver beetles (*Ips avulses, Ips grandicollis, and Ips calligraphus)*.

Specific areas of observed pest infestations were located in southwest Louisiana and southeast Louisiana. West Bay Wildlife Management Area in Allen Parish, Louisiana was an area with observed infestations (Tina Meiners, Forest Capital Partners, Inc, 2007). Hurricane Katrina made landfall in August, 2005 at Buras, Louisiana 240 miles southeast of the study area. Hurricane Rita made landfall at Sabine Pass in September, 2005, 103 miles southwest of the study area. In West Bay Management Area, BTB infestations were verified by specific symptoms observed in the pine stand. These identifying factors included specific pitch tubes at the lower 10 feet of the tree, bark dust at the base of the tree, and actual beetle presence (Fatzinger, 1969).

A pilot study was conducted to estimate the potential slash pine (*Pinus elliottii*) timber loss on a 134 acre tract in West Bay. Damaged slash pine trees were tallied, mapped, and valued by board feet. The results of the study were compared to the expected loss that Forest Capital Partners, Inc and literature indicated over the life (28 years) of the slash pine stand.

The estimated total production of board footage is 157 trees per acre, with an estimated mean of 30 board feet per harvestable tree (4710 board feet per acre) (Tina Meiners, Forest Capital, 2007). Over the life of the stand (28 years), the expected loss of standing timber to insect pests is 3-5% (Tina Meiners, Forest Capital Partners, Inc, 2007).

The pilot study area contained 21,000 total trees (Figure 1.1, geology.com). There were 59 trees infested within the 20 % sampling area. In the entire area, 295 trees would be expected to have infestations. A total of 295 trees at a mean of 24.4 board feet per tree would be 7,200 total board feet lost in one year. A total board feet expectation is 21,000 trees at 24.4 board feet per tree. The area contained a potential of 513,537 board feet. At a loss of 7,200 out of 513,537 board feet is a 1.4 % loss per year.

PURPOSE

Based on the pilot study, the purpose of this research was to estimate and compare the number of trees and board footage loss among four selected slash pine timber stands

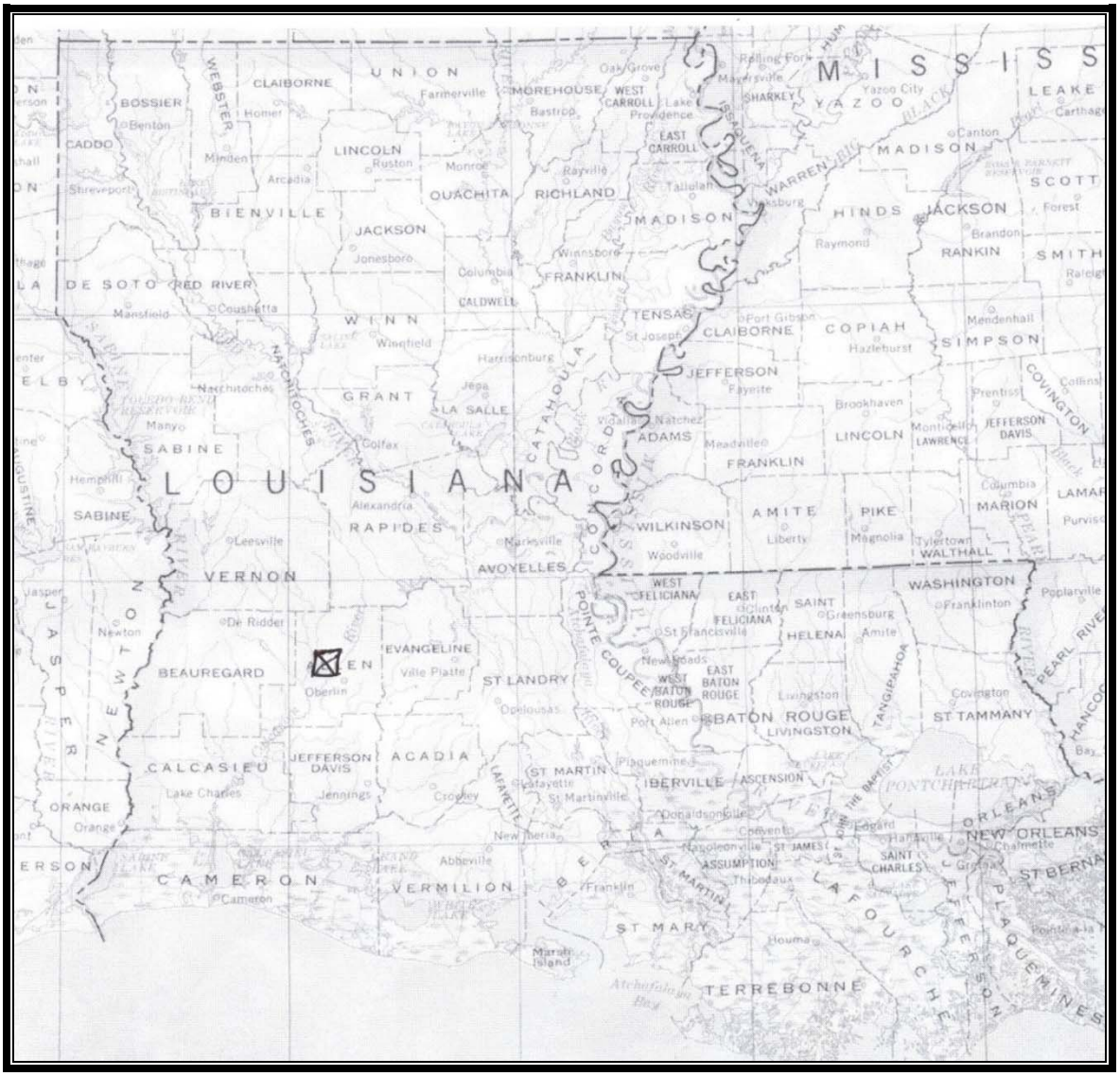

Figure 1.1. Map of the Study Area sampled in West Bay WMA in Allen Parish, Louisiana. (geology.com stock photo, 2007)

that were affected by Hurricane Rita and infestation by the BTB. In addition, the post-hurricane-BTB losses will be compared to the expected normal losses indicated in literature and by Forest Capital Partners, Inc. predicted from pests over the life of a slash pine stand. The information produced from this study will assist timber managers and landowners to better understand potential losses due to hurricanes and consequential BTB infestations.

OBJECTIVES

1. To estimate the board footage loss to the BTB by randomly sampling four selected slash pine stands that were affected by Hurricanes Katrina and Rita.
2. To compare the estimated board footage loss of each site to determine if a significant difference in timber exists among the four sites.
3. To compare the estimated potential loss of the BTB infestations to the pest induced losses expected by Forest Capital Partners, Inc.

STUDY SIGNIFICANCE

The loss of merchantable pine timber due to post-hurricane BTB infestation presence has not been estimated. This study compares the board footage losses in four hurricane affected areas infested by the BTB and provides foundational information for predicting and estimating future post-hurricane BTB

losses. This information will assist managers and private landowners in estimating the economic losses due to post-hurricane induced BTB infestations.

CHAPTER 2

REVIEW OF LITERATURE

POST-HURRICANE PINE DAMAGE

Due to the unpredictability of nature, producing a sustainable profit from renewable natural resources is challenging. Pine timber is a prominent Louisiana agricultural resource that provides for a highly diversified workforce and market place (Hurwitz, 2006). The forestry industry is also the largest agricultural commodity in Louisiana, producing 4.6 billion dollars in 2006.

The Black Turpentine Beetle (BTB) has previously caused an extensive amount of damage to southern states (Hurwitz, 2006). The BTB generally can destroy up to 10 % of a stand during a single season (Smith and Lee, 1972). This rate is dependant upon amount of damage the stand undergoes due to stress (weather, fire, disease, or harvesting). Hurricanes Katrina and Rita destroyed thousands of acres in Louisiana pine timber in 2005. Hurricane Katrina struck the southeastern Louisiana coast in August, 2005 at Buras, Louisiana. In September of 2005, Hurricane Rita struck the southwest Louisiana area at Sabine Pass. Loblolly (*Pinus taeda*) and slash pine (*Pinus elliottii*) stands were affected by hurricane winds and post-hurricane drought conditions, which have been shown to increase the opportunities for BTB infestations (Cranshaw and

Leatherman, 2004). The effects of these natural disasters and BTB infestation are the focus of this thesis.

Due to hurricane wind damage, post-hurricane drought, and the possible attack of other pine beetles, many pine trees were stressed and physically damaged, which provided access for the BTB. The BTB bores tunnels in the cambium layer, which reduces or stops the flow of sap and nutrients and kills the tree. Bob Odom, former Louisiana Agriculture and Forestry Commissioner, indicated that a certain amount of BTB damage occurs annually (Hurwitz, *et al*, 2006). However, pines that were hurricane stressed were more susceptible to the opportunistic BTB (Hurwitz, *et al*, 2006).

Payne (1999) noted that pine beetles can rapidly infest and destroy a timber stand. Depending on the pine beetle species and population size, the acreage of lost pine timber varies by specific pine beetle species. Three primary pine beetles are found in Louisiana (Connor and Wilkinson, 1983): the Southern pine beetle (*Dendroctonus frontalis*), pine engraver beetles (*Ips* spp.) consisting of three species: eastern six-spined engraver (*Ips calligraphus*), the five-spined engraver (*Ips grandicollis*), and the four-spined engraver (*Ips avulses*), and the black turpentine beetle (Connor and Wilkinson, 1983).

SLASH PINE ECOLOGY

Slash pine (*Pinus elliottii*) is the prominent species in the southwest timber industry. According to Hansborough (1956), slash pine is not a native species to the area, but was planted in Louisiana for various reasons. Slash pines demonstrate faster initial growth rates, a resistance to fire, and an overall higher survival rate (Hansborough, 1956). For these reasons, slash pine became a popular pine species in the timber industry.

VARIOUS PINE BEETLE INFLUENCE

When other beetles infest a stand or stress pine timber, BTB presence is likely to occur (Connor and Wilkinson, 1983). The Ips beetle and Southern Pine beetles are the primary pest infestation stress factors in the timber industry that can attract BTB to a stand (Connor and Wilkinson, 1983).

Ips beetles: Similar to BTB, Ips beetles tend to attack trees that have been previously weakened (Connor and Wilkinson, 1983). In Texas, Pase (2002) observed the combined effects of Ips and BTB that resulted in mortality after a period of drought in 1998. The distribution of Ips beetles has spread from the Gulf of Mexico areas to the Northeastern United States (Connor and Wilkinson, 1983). Signs of Ips infestations are: a change in needle color from green to yellow or red, boring dust in bark crevices, and

small, dime sized pitch tubes (Connor and Wilkinson, 1983). Adult Ips beetles also carry bluestain fungus (*Ceratocystis ips*) which is excreted in beetle feces when infested. The bluestain fungus will block the flow of water throughout the host tree and can directly cause mortality (Connor and Wilkinson, 1983). When Ips beetles emerge from the host tree, they leave small holes in the outer bark (Connor and Wilkinson, 1983).

Ips beetles are observed to be light orange brown to black in color. According to Connor and Wilkinson, adult Ips beetles have a hollowed out posterior (1983). The BTB has a rounded posterior with no protrusions as the Ips has easily noticed spines on the posterior. The number of spines protruding from the posterior can be used to identify which Ips species is present. Also, the Ips beetle is less than 6 mm long, depending on the individual species, while the BTB is 10 mm long in the adult stage (Mulder, 2002). Control methods involved in the control of Ips beetles is similar to the BTB. However, Ips beetles tend to attack the upper portion of the host tree while the BTB attacks the lower portion.

When attacking a host tree, the male engraver beetles are the first to arrive at a potential host tree and will emit a pheromone to attract other beetles (Jarratt, 2001). Females will excavate galleries in order to deposit eggs and the eggs will start to hatch in 7 days (Jarratt, 2001). Ips beetles may have 4-6 generations within one infestation year (Jarratt, 2001).

Southern Pine Beetles: When the Southern Pine Beetle (SPB) is identified at an infestation site, the Ips beetle is generally present (Payne, 1999). Spatial distribution among the beetle species on a host may occur as well as overlap (Payne, 1999). The SPB is found in the middle and lower portion of an infested tree, the Ips beetle is found in the middle and upper portion of a tree, and the BTB is found in the lower portion (Payne, 1999). The SPB and Ips beetle can be contrasted by different physical characteristics as well as symptoms of infestations. The SPB has a visible head when viewed from above while the Ips does not (Payne, 1999). Ips beetles have egg galleries that are distinctive in an "H" or "Y" pattern and the SPB has an "S" shaped egg gallery (Payne, 1999) (Table 2.1).

BLACK TURPENTINE BEETLE LIFE HISTORY AND BIOLOGY

The adult BTB is dark brown to black in color and 10mm in length. A key to identifying the adult turpentine beetle is the prominent round posterior (Billings, 1989). The female emits pheromones and is joined by a single male in the gallery (Mayfield and Foltz, 2005). To reproduce, the female builds a series of downward tunnels in the interface of the cambium layer and inner bark. This series of tunnels is an egg gallery, in which the female deposits rows of eggs (Baker, 2005). Hatching occurs within 10 to 14 days, and the larvae feed on the phloem for 35 to 49 days. As the larval population

increases, individual galleries join to form broad communal galleries (Baker, 2005). Eventually, the interlocking galleries girdle and kill the tree (Baker, 2005).

When the larva matures, the larva pupates between the bark and the sapwood. The pupation period ranges from 10-14 days (Baker, 2005). The adults emerge through the bark and the cycle is repeated. The full grown larvae are white with a reddish-brown head and are 8 mm in length. The pupae are 6 mm in length, and yellowish in color (Billings, 1989). The life cycle is 3-4 months, with various generations that can overlap throughout the year (Baker, 2005). During the timber growing season, the emergence of beetles can be expected to occur throughout the summer (Baker, 2005). Reproduction is slowed during the cooler months (Baker, 2005).

The BTB are attracted to damaged, weakened, or recently harvested stands (Almquist, 2003). The BTB will attack an individual pine tree that is emitting the odor of fresh resin, which indicates that the tree's defenses have been compromised (Baker, 2005; Mayfield and Foltz, 2005). As resin flow decreases, the BTB has unimpeded access within the cambium layer. The attacking BTB is typically a female and the attack normally occurs within the lower 10 feet of the tree trunk (Billings, 1989). The pheromone used in both sexes of BTB for communication is endobrevicomin (Payne, 1999). Endobrevicomin is released in small amounts in order to signal other BTB populations of a host tree presence (Payne, 1999).

TABLE 2.1. Location of Pine Beetles on infested host tree

Beetle	Location of tree	Gallery Shape
BTB	lower ten feet	“D” shape or no shape
SPB	middle portion	"S" shape
Ips	upper portion	"H" or "Y" shape

Indication of the various locations of BTB, SPB, and Ips beetles as they are found on a host tree and the shapes of the galleries found under the bark of the host tree.

If the female is successful in overcoming the defense mechanism (resin), a pitch tube is created by the resin flowing out of the entrance hole (Figure 2.1, USDA), and a series of tunnels (galleries) will be located near the pitch tube in the cambium layer (Mayfield and Foltz, 2005). Evidence of BTB boring is pitch tubes on the tree (Figure 2.1, USDA), the collection of sawdust around the base of the tree (Figure 2.2, Richard Johnson), and fan shaped galleries (Figure 2.3, Richard Johnson).

CONTROL METHODS FOR THE BLACK TURPENTINE BEETLE

The BTB attacks the lower part of an individual tree; therefore, control methods may be applied at a smaller area of the host tree. This is a more feasible control area than control areas for pests that attack the forest canopy (Clark, 1970). Many methods for control of the BTB can be used in order to prevent an infestation site from spreading, or to prevent new initial attacks. Methods for prevention of further outbreaks include avoiding thinning of the stand, avoiding compaction of pine root zones, avoiding trunk wounds, and providing additional nutrients to the soil in order to maintain tree stand vigor (Mayfield and Foltz, 2005).

Methods for destroying the BTB in individual trees include: hammering the pitch tubes, sawing the pitch tubes away, saturation of the tree, or spraying a lindane solution on the lower part of the tree (Baker, 2005). Natural enemies of the BTB are Ips beetles,

Figure 2.1. Picture of pitch tubes observed on host tree. (photo by USDA Forest service, 2005)

Figure 2.2. Picture of sawdust observed around the base of host tree. (Photo by Richard Johnson, 2007)

Figure 2.3. Picture of BTB galleries observed on host tree. (Photo by Richard Johnson, 2007)