

**A DENROECOLOGICAL ANALYSIS OF DISTURBANCE OF
REMNANT *PINUS PALUSTRIS*, SOUTHEASTERN VIRGINIA**

ARVIND ANIEL ROMBAWA BHUTA

Thesis submitted to the Faculty of
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE
IN
GEOGRAPHY

Lisa M. Kennedy, Ph.D., Committee Chair
James B. Campbell, Ph.D.
Carolyn A. Copenheaver, Ph.D.
Philip M. Sheridan B.A., M.S., ABD

Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

28 April 2006

Keywords

Pinus palustris, dendroecology, climate, disturbance, population dynamics, Virginia

A DENROECOLOGICAL ANALYSIS OF DISTURBANCE OF REMNANT *PINUS PALUSTRIS*, SOUTHEASTERN VIRGINIA

ARVIND ANIEL ROMBAWA BHUTA

Abstract

Pinus palustris Miller (longleaf pine), in Virginia, is at the northernmost extent of its range. During presettlement times, this species occurred throughout the Piedmont and Coastal Plain of Virginia in pure and mixed stands, covering 607,000 hectares. This forest type has since been reduced to 81 hectares or 0.01% of its former range. Around 5,000 individual *Pinus palustris* remain on six sites in the coastal plains. Seacock Swamp and Everwoods are both sites known to have naturally regenerated *Pinus palustris* native to Virginia occurring in mixed-species stands. At both sites, I measured height and diameter of all *Pinus palustris* and cored individuals greater than 10 cm in diameter at breast height. A total of 71 trees were cored; the cores were crossdated and measured and crossdating was verified with the COFECHA program. A strong competition signal within the tree ring records at both sites signified the importance of stand dynamics on *Pinus palustris* in second-growth loblolly pine stands. These results are probably due to the mix of species within these stands and competition from loblolly pine as both the dominant understory and overstory species. Using Black and Abrams (2003) boundary line method, we calculated release and suppression events from the tree-ring record over the last century and found a very dynamic system. During the 1950s and 1960s, Seacock Swamp experienced major and moderate releases (23% moderate release and 18% major release in the 1950s and 33% moderate release and 49% major release in the 1960s) in response to a diameter-limit cut in 1953. Other major and moderate

releases varied at both sites and may be attributed to different forest management practices that were in place throughout the last century however locating historical land use records to validate this was not possible at the present.

Acknowledgements

I would like to acknowledge my committee, Lisa M. Kennedy, Carolyn Copenheaver, Jim Campbell, and Philip Sheridan for their valuable insights into the development, writing, and preparation of my thesis. Bryan Black at Oregon State University offered valuable insight into the development of the boundary line method for *Pinus palustris*. John R. Winston and Ben Logan assisted with data collection and fieldwork. Bill Apperson provided assistance with the collection of cores from field sites across southeastern Virginia and introduced me to T.L. Bain. International Paper and T.L. Baine provided access to their lands, without which this study would not been possible. Finally, I would also like to thank my family for their support and love while I was pursuing my Master's degree.

Table of Contents

	Page
Abstract.....	ii
Acknowledgements.....	iv
Table of Contents.....	v
List of Figures.....	vi
List of Table(s).....	viii
Chapter 1: Introduction and Statement of Purpose.....	1
1.1 Introduction.....	1
1.2 Statement of Purpose.....	2
Chapter 2: Literature Review.....	8
2.1 Introduction.....	8
2.2 Life History and Ecology of <i>Pinus palustris</i>	8
2.3 The Role of Fire in the <i>Pinus palustris</i> Ecosystem.....	10
2.4 The History of the <i>Pinus palustris</i> Ecosystem in Virginia.....	11
2.5 The Present Status of <i>Pinus palustris</i> in Virginia.....	14
2.6 Dendrochronology of <i>Pinus palustris</i> in the southeastern U.S.A.....	16
2.6.1 Introduction.....	16
2.6.2 Wood Anatomy.....	18
2.6.3 Population Dynamics.....	18
2.6.4 Dendroclimatology.....	20
2.6.5 Disturbance History.....	26
2.7 The Boundary-Line Growth Method.....	27
Chapter 3: Disturbance histories for remnant <i>Pinus palustris</i> in southeastern Virginia using the boundary-line growth method.....	37
3.1 Introduction.....	38
3.2 Materials and Methods.....	41
3.2.1 Study area and sites.....	42
3.2.2 Field methods.....	43
3.2.3 Laboratory methods.....	44
3.3 Results.....	45
3.3.1 <i>Pinus palustris</i> population.....	45
3.3.2 Disturbance analysis.....	46
3.4 Discussion.....	47
3.4.1 Population distribution.....	47
3.5 Conclusions.....	50
3.6 Acknowledgements.....	50
Vita.....	63

List of Figures

	Page
Figure 1.1. Distribution of the <i>Pinus palustris</i> ecosystem throughout the southeastern United States (modeled after Little 1971; Frost 1993; Sheridan et al. 1999).....	6
Figure 1.2. Distribution of the <i>Pinus palustris</i> ecosystem throughout the ecoregions of the southeastern United States (Woods et al. 1999; modeled after Little 1971; Frost 1993; Sheridan et al. 1999).....	7
Figure 2.1. The range of <i>Pinus palustris</i> in Virginia. (Modeled after Frost 1993; Sheridan et al. 1999).....	33
Figure 2.2. Four of the five sites containing extant <i>Pinus palustris</i> in southeastern Virginia (Kume and Surry site not shown).....	34
Figure 2.3. Size distribution of <i>Pinus palustris</i> at the Kume, Everwoods, Seacock Swamp, Blackwater Ecological Preserve, and South Quay.....	35-36
Figure 3.1: Location of the Seacock Swamp and Everwoods study sites in southeastern Virginia. Modeled after Frost (1993).....	55
Figure 3.2: Size-class distribution of <i>Pinus palustris</i> at Everwoods and Seacock Swamp in southeastern Virginia in 2004.....	56
Figure 3.3: Age-Class distribution of longleaf pines at Everwoods and Seacock Swamp.....	57
Figure 3.4: Calculation of the boundary line for longleaf pine and its application to all sites with longleaf pine found in the ITRDB and for the two study sites Everwoods and Seacock Swamp.....	58
Figure 3.5: Major, moderate, and no release events for Everwoods and Seacock Swamp.	59
Figure 3.6: Major and moderate releases of annual rings for longleaf pine at Everwoods based on boundary line method (Black & Abrams 2003) at the decadal scale.....	60

Figure 3.7: Major and moderate releases of annual rings for longleaf pine at Seacock Swamp based on boundary line method (Black & Abrams 2003) at the decadal scale.....61

List of Table(s)

Table 3.1: A) Everwoods and B) Seacock Swamp. Table shows release by decade in number and percentage for both sites from 1900-2000.....62