

ABSTRACT

EWING, JUSTIN MUSTER. Characterization of Soils in a Drained Carolina Bay Wetland Prior to Restoration. (Under the direction of Michael Vepraskas.)

Carolina bays are oval shaped depressions, located in the Atlantic Coastal Plain, that are wetlands. Many of these bays have been drained and used for agriculture. Drained Carolina bays have the potential to be excellent sites for wetland restoration. The purpose of this research was to evaluate the soils in a drained Carolina bay wetland, called Juniper Bay, to determine the potential for a successful restoration of wetland hydrology and vegetation. Juniper Bay is typical of most Carolina bays. It was formed in Pleistocene material and filled with Holocene material. The center depression has organic soils with an underlying buried soil and an impermeable layer. Historical research revealed that Juniper Bay was drained in three phases roughly 30, 20, and 15 years ago and placed into agricultural production.

The process of draining the soils for agricultural use resulted in subsidence of the organic soil. Using a method comparing bulk density of the drained organic soil to the bulk density of an undrained Carolina bay soil, an estimate of primary subsidence was obtained. Secondary subsidence was estimated using changes in bulk density and changes in the amount of sand from the lower organic horizon to the surface organic horizon. The average rate of primary subsidence was estimated to be 3.9 cm yr^{-1} for the first 10 years since drainage, and an average rate for secondary subsidence was estimated to be 2.0 cm yr^{-1} . Subsidence values were variable across Juniper Bay and with no correlations related to locations at the crest of a field or near a ditch.

Three natural Carolina bay wetlands located in an adjacent county were used as reference bays because they were undrained and had forest vegetation. The relatively low variability in physical and chemical properties among the reference bays revealed that the

data could be satisfactorily used to evaluate plant needs and hydraulic conditions in restoration projects. The soils in Juniper Bay were grouped according to the thickness of organic material; organic (<60cm), histic (40-60cm), and mineral (<20cm). Juniper Bay soil groups were evaluated against similar soils in the RB, the length of time in agriculture, and for differences between crest and ditch locations.

All soil types had higher nutrient levels, base saturations, and pHs, but lower organic carbon contents, cation exchange capacities, and total nitrogen levels the longer the soils had been in agricultural production. The length of time the soils were drained influenced the depth to which there were differences in soil properties. Depth of nutrient leaching increased from 40cm at 15 years to 65cm by 30 years. Similar trends were present when comparing Juniper Bay to the reference bays. Juniper Bay had higher nutrient levels and lower amounts of organic carbon. Differences were minimal between crest and ditch locations.

Soils in Juniper Bay no longer have the same physical properties that are present in the reference bays. The Oi and Oe horizons are absent. The Oa horizons are thinner and organic carbon levels are lower, while the bulk density, K_{sat} , and aggregation have increased. Soils near the ditch tend to have thinner organic horizons and larger aggregates than soils near at the center of the fields.

There are several implications of this study for restoring Juniper Bay into a wetland. Subsidence due to drainage and agricultural production has lowered the surface by approximately 60cm. The original water table was believed to have been at the original surface for part of the year. Plugging all the ditches could result in open water. The increased levels of nutrients could allow invasive species to out compete desired Carolina bay vegetation that thrives in nutrient poor acidic conditions.

**CHARACTERIZATION OF SOILS IN A DRAINED CAROLINA BAY WETLAND
PRIOR TO RESTORATION**

by
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Chair of Advisory Committee

DEDICATION

I would like to dedicate this dissertation to my wife, Angela Ewing. She allowed me to drag her from her native soil of Texas and post pone life to move to North Carolina so I could pursue a doctorate at N.C. State. Although she missed the wide-open skies of Texas she learned to enjoy the seasons of North Carolina and made close friends. She supported me financially and emotionally for three years. There were many times when the knowledge of the sacrifices she made spurred me to forge ahead. I can never repay her for her patience, encouragement, and occasional goofiness. I believe that our experiences and struggles in Raleigh have made us a stronger couple. From the bottom of my heart, thank you.

BIOGRAPHY

Justin Muster Ewing was born in Hardinsburg Kentucky on May 26, 1975 to Verda Kay and John Henry Ewing III. He grew up on a 75 acre cattle and tobacco farm next to Rough River Lake outside Leitchfield, KY. He attained Eagle Scout rank in 1991. He graduated from Grayson County High School in 1993. He spent his freshman year at Elizabethtown Community College and then attended the University of Kentucky where he graduated magna cum laude from the College of Agriculture with a degree in Plant and Soil Science in 1993. He continued on at the University of Kentucky and received a Masters in Plant and Soil Science with an emphasis in Weed Science in 2000. It was during his Masters studies that he met his future wife thru his roommate's church's annual meeting in June 1998. Her name was Angela Moore and she was an English teacher in Austin, Texas. They had a long distance courtship through letters, emails, phone calls and occasional visits. Angie met Justin's mother once before she past away from brain cancer in October of 1998. The following summer Justin and Angie were engaged and were married on January 22, 2000 in Austin Texas. They lived in Austin where Angie continued to work as a teacher and he worked on a survey crew. They moved to North Carolina in July of 2000 so he could pursue a doctorate in Soil Science at North Carolina State University. Angie also pursued a masters at NCSU in Curriculum and Instruction while continuing to teach. Justin received a job offer from Lopez Garcia Group to be an Environmental Specialist for State Highway 130 project in Austin Texas, and as of July 2003 the Ewings have returned to Austin.

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