MANAGING FORESTED WETLANDS WITH FIRE IN A CHANGING CLIMATE

ALLIGATOR RIVER
NATIONAL WILDLIFE REFUGE
MANTEO, NORTH CAROLINA
NOVEMBER 19-21, 2013

Welcome!

We are excited that each of you were able to join us today. The goal of this symposium is to increase the knowledge base for the issues regarding the management of forested wetlands with fire in an environment affected by climate change. A wide audience of local and regional land and resource managers, educators, researchers, and planners will benefit from attending or reading the proceedings from this workshop.

This symposium was funded by the Joint Fire Science Program with support from the Southern Fire Exchange, FWS Southeast Region's Fire Management Division, and the Coastal Wildlife Refuge Society. We are grateful for all the support that helped make this symposium possible.

- Sue Wilder and Kelley Van Druten
Symposium Coordinators

Managing Forested Wetlands with Fire in a Changing Climate Symposium

Gateway Visitor Center, Manteo, NC
Alligator River National Wildlife Refuge
Tuesday November 19—Thursday November 21, 2013

Tuesday, November 19, 2013	
7:30-8:30	Registration and Coffee
8:30-8:45	Welcome, Symposium Purpose, Introductions, and Agenda Overview
8:45-9:40	Keynote Cecil Frost 428 Years of Change in Forested Wetlands: An Accelerating Rollover
9:40-10:00	BREAK
10:00-10:15	Mike Bryant and Scott Lanier Management Concerns and Challenges
10:15-11:00	Stan Riggs Sea-Level Rise in North Carolina: Past History and Future Impact on the US Fish and Wildlife Service Refuges and Coastal System in NC
11:00-11:30	Gary Curcio Fire Danger Rating for Organic Soils
11:30-1:00	LUNCH

Tuesday, November 19, 2013 Cont'd	
1:00-1:25	Christine Pickens Building Sea-Level Rise Resilience and Water Management Capability at Alligator River NWR and Dare County Bombing Range
1:25-1:50	Sara Ward Ecological Considerations for Forested Peat Wetlands: Meeting Biological Objectives at the Landscape Scale
1:50-2:15	Dennis Stewart Priority Concerns for Wildlife and Habitat Management in Coastal Wetlands
2:15-2:35	BREAK
2:35-3:00	Laura Mitchell Effects of Recent Fires at Great Dismal Swamp NWR, 2002-2012
3:00-3:25	Ed Christopher Wildfire Management on Peat Soils
3:25-3:40	BREAK
3:40-4:10	Kelley Van Druten History of Prescribed Fire on the Alligator River NWR
4:10-4:30	Field Trip Logistics
4:30-5:00	Discussion and Day Wrap up

Wednesday, November 20, 2013	
8:00-5:00	Kelley Van Druten/ Bert Plante/ Donnie Harris/ Tom Crews Field Trip

Thursday, November 21, 2013	
8:00-8:30	Kelley Van Druten/ Bert Plante/ Donnie Harris/ Tom Crews Field Trip Wrap-up
8:30-8:55	John King Assessing Hydrologic and Salinity Thresholds Driving Ecosystem Transition at Alligator River National Wildlife Refuge
8:55-9:20	Robert Mickler Carbon Emissions from Recent Peatland Fires
9:20-9:35	BREAK
9:35-10:00	Tim Craig Water Handling Operations in Peat Soil
10:00-10:25	Pete Benjamin Landscape Conservation Design in Eastern North Carolina and Southeastern Virginia
10:25-10:40	BREAK
10:40-11:55	Brainstorming Group Activity
11:55-12:00	Symposium Wrap up
12:00	End of Symposium

Keynote Address

428 Years of Change in Forested Wetlands: An Accelerating Rollover

Cecil Frost, PhD., Landscape Fire Ecologist, Research Collaborator, UNC

Historically—with exception of the sea level swamps such as those along the margins of the Alligator River—nearly all original vegetation of the coastal lowlands was in some way structured by fire. Fire history studies completed in 2006 for Mainland Dare County and in 2013 for the Hyde-Tyrrell-Beaufort peninsula show a broad range of original fire regimes, with frequencies ranging from around 3-5 years in some areas of savanna and canebrake to 50-300 years in Atlantic white cedar wetlands. Long before the first Roanoke voyage, and over the centuries since sea level began to approach modern levels, interior forested wetlands had been changing in tandem with sea level rise. As a consequence, both the mosaic of vegetation types and their associated fire regimes have crawled inland with the ongoing change. There were oscillations in salinity following opening and closing of inlets along the Currituck portion of the Outer Banks, causing multi-decadal swings in the lower Albemarle between flammable brackish marsh and nonflammable tidal cypress-gum swamp. Vast peat domes rose in the interior of the peninsula around Phelps Lake and the southern half of mainland Dare. In the two and half centuries since settlers began farming what dry lands they could find around the perimeter of the sounds, sea level has continued to tick upward.

Thomas Pain's house (1765) at the head of Pain's Bay now lies under brackish marsh and you can slosh through ankle deep water under pond pines where mesic oak forest was cleared for farming north of East Lake around 1748. Under mainland Dare and the rest of the Pamlimarle peninsula there is a subsurface landscape of mineral soil beneath the peat that was all dry land in the last 500 to 1000 years. In the interior, water table rises in tandem with sea level. The resulting slow mantling of the lowlands with peat as the water table rises is a natural process that begins as moist mineral soils (Aquults) begin to accumulate organic matter, transitioning into Humaquepts and then to shallow peat (Terric Medisaprists). With these changes, interior forests undergo slow but predictable transitions that could be mapped for at least a few decades into the future using soils and LiDAR elevation. The rate of landscape change resulting from the normal train of fire regime change, in response to vegetation change, in response to soil change, in response to sea level rise, is accelerating. We can best manage lands in the public trust by accepting these changes, understanding the coming vegetation translations to expect at each point in the landscape and overseeing them so that the transitions in vegetation and fire regimes and the wildlife species that accompany them occur as they would in nature.

Management Concerns and Challenges

Mike Bryant and Scott Lanier, Project Leader and Deputy Project Leader, Alligator River NWR, Manteo, NC

Alligator River NWR was established to protect and preserve pocosin habitat and forested wetlands. Our challenge is to use fire as a tool in a fire adapted landscape at the same time knowing that the landscape is being negatively affected by sea level rise and salt water intrusion. We see the habitat changing: what once was marsh is now open water, shrubs have changed to marsh, and forests have changed to shrubs. We want to use fire but don't want it to be the tipping point, the additional stressor, which moves the habitat to the point of no return. Climate change models show us loosing what we have. How can fire help us find the balance to make the landscape as resilient as possible so we can hold onto the pocosin and forested wetlands as long as we can?

Sea-Level Rise in North Carolina: Past History and Future Impact on the US Fish and Wildlife Service Refuges and Coastal System in NC

Stanley Riggs, PhD., Distinguished Research Professor of Geology, East Carolina University, Greenville, NC

This talk is based on a half century long research program in the world's coastal systems and is summarized in our recent (2011) book titled: "The Battle for North Carolina's Coast: Evolutionary History, Present Crisis, and Vision for the Future" published by UNC Press. Much of the data for this presentation comes from the NC refuges and surrounding water bodies.

Fire Danger Rating for Organic Soils

Gary M. Curcio[1] and Jim Reardon [2]

[1]Forester, IPA Fire Environment Specialists, LLC, La Grange, NC.
[2]Fire Ecologist / Forester, US Forest Service Rocky Mountain Research Station, Missoula Fire Lab, Missoula, MT

There is an increasing appreciation of the ecological role that fire plays in the creation and stability of many wetland communities. The forest and shrub dominated wetland communities common on the North Carolina coastal plain are characterized by large amounts of live and dead surface fuels which have the potential to support intense flaming combustion for relatively short durations. In addition these communities are also associated with thick organic soil horizons that have the potential to support smoldering combustion of relatively long durations. These wetlands present unique fire management challenges.

To improve management effectiveness North Carolina natural resource management agencies would like to increase controlled burning opportunities. Increased burning is dependent on the integration of new science and tools to meet the combined pressures of controlled burning, suppression of wildfires, regulatory requirements, and the increasing complexity of air-sheds and associated smoke sensitive areas. Ultimately the effectiveness and of Fire Danger, Smoke Management, Prescribed Fire, Predictive Services and Suppression Programs are dependent on the successful integration of science and operational skills.

Our research is focused on one aspect of the management of these communities, the sustained smoldering combustion of the organic soils. By quantifying the burning conditions of organic soils through Estimated Smoldering Potential (ESP), managers can be informed as to the probability of organic soils sustaining combustion. This information will improve the decision making processes and the options to be considered within prescribed fire, suppression and smoke management programs.

The estimation of smoldering potential requires soil moisture information. Currently, soil moisture measurements are made by our ESP Fire Danger Stations which are positioned in our study sites on NC's Coastal Plain. It is planned to: 1) develop an ESP fire danger adjective rating whereby burning conditions can assessed and displayed on the NC State Climate Office / NCFS Fire Weather / Fire Danger Intel Portal, 2) explore NASA's Soil Moisture Active Passive Satellite capabilities with the intent to correlate remote sensed satellite information with station collected information, and 3) develop information for the National Emission Inventory process as to when to include emissions from organic soils.

Building Sea-level Rise Resilience and Water Management Capability at Alligator River NWR and Dare County Bombing Range

Christine Pickens, Coastal Restoration and Adaptation Specialist,
The Nature Conservancy, Nags Head, NC

The combination of low elevation, peat soil, and extensive ditching has proved to be a formidable challenge in terms of land and water management at Alligator River National Wildlife Refuge (NWR) and Dare County Bombing Range. Unmanaged ditches allow saltwater to move into the interior freshwater forested swamps and pocosin, resulting in standing dead trees and shrubs. These ditches also allow freshwater to drain off of the land resulting in lower groundwater tables, organic soil oxidation, and loss of water for firefighting. The Nature Conservancy (TNC) is implementing and monitoring hydrologic restoration as part of the Albemarle-Pamlico Climate Change Adaptation Project to prevent saltwater intrusion and manage for more natural water patterns through ditch modifications. Currently, TNC, the U.S. Fish and Wildlife Service, and the U.S. Air Force are partnering on a water management plan that will inform, guide, and implement improvements to the ditch network. Specifically, the goals of the water management plan are to maintain groundwater levels, provide sources and conveyances of water for firefighting, and limit saltwater intrusion. Knowledge gained from plan development will be shared along with a site-specific example of how modifications to the ditch network will lead to improved land and water management.

Ecological Considerations for Forested Peat Wetlands: Meeting Biological Objectives at the Landscape Scale

Sara Ward[1] and Chuck Hunter[2]

[1] Ecologist, Raleigh Ecological Services Field Office, FWS, Raleigh, NC.
[2] Chief, Division of Strategic Resource Management, Southeast Region, FWS, Atlanta, GA

The presentation will provide an overview of the importance of setting population objectives for umbrella species associated with forested wetland habitats. The talk will also highlight a spatial framework to meet species-specific population objectives and management tools (fire, hydrology, forestry) to achieve the range of desired habitat conditions. We will also briefly discuss the potential for carbon sequestration projects to advance our management goals.

Priority Concerns for Wildlife and Habitat Management in Coastal Wetlands

Dennis Stewart. Wildlife Biologist, Alligator River NWR, Manteo, NC

Refuges and other conservation lands with coastal wetlands require special considerations when planning management actions for those habitat types. Climate change as manifested through rising sea level, salt-water intrusion, and storms is inducing rates of habitat change much higher than would be expected under more normal circumstances. Additional stresses can be caused by various management actions such as ditching, fire, and farming. These actions result in much higher rates of subsidence in organic soils, exacerbating the effects of sea level rise. Such effects must receive further consideration before planning and implementing management actions more so today than ever. Careful attention must be given to writing goals and objectives for managing wildlife habitat in these settings. Monitoring to determine the degree of success is essential.

Effects of Recent Fires at Great Dismal Swamp NWR, 2002-2012

Laura Mitchell. Ecologist, Northeast Region, FWS, Smyrna, DE

First, I describe the historic composition of the forest lands now constituting the U.S. Fish and Wildlife Service's Great Dismal Swamp National Wildlife Refuge, and significant forest type changes wrought by 2 centuries of human influence, such as drainage ditch construction, major timber operations, and altered fire regimes. I describe recent influences (2002-2012), including coastal storms, anthropogenic intervention (timber salvage operations), and changing drought cycles, and the drastic changes these drivers have brought about in the central region of the swamp, including Atlantic White Cedar loss, organic soil loss, elevation changes in the forest floor, forest canopy loss, and invasive plant colonization. I conclude with steps the Refuge is taking to restore hydrology in the forest (increasing flooding frequency and duration), combat invasive plants, and create stable, interim native plant community types.

Wildfire Management on Peat Soils

Ed Christopher. Fire Management Officer, Pocosin Lakes NWR, Columbia, NC

The ignition and persistent smoldering of peat soils if not controlled quickly can become a topography changing event. This fact becomes increasingly apparent when considering low elevations associated with Coastal North Carolina and the prospect of sea level rise. Finding sufficient water sources to put the fire out is a significant obstacle for peat soil fires because of the logistics involved to move high volumes of water over distance. Additionally, compounding fire suppression concerns is locating sufficient fresh water sources to prevent long duration inundation of brackish water over the landscape.

History of Prescribed Fire on Alligator River NWR

Kelley Van Druten, Refuge Operations Specialist, Alligator River NWR, Manteo, NC

The presentation will summarize the number of acres prescribed burned on the refuge from the 1990s to present. Success stories of hazardous fuel reduction burns as well as a photo gallery of habitat impacts will be presented. The reasons for conducting prescribed burns on the refuge and the challenges in doing so will be discussed. The presentation will end by stating where the refuge is to date with it Fire Management Plan rewritten in 2013.

Assessing Hydrologic and Salinity Thresholds Driving Ecosystem Transition at Alligator River National Wildlife Refuge

John King, PhD., Dept. of Forestry and Environmental Resources, North Carolina State University, Raleigh, NC

Low elevation, historical ditching, and exposure to recurring storms interact to make the Alligator River National Wildlife Refuge extremely vulnerable to sea level rise (SLR). In particular, changes in hydrology and salinity associated with SLR are causing drastic transition, both in extent and rate, of ecosystems across the Refuge, although the driving mechanisms remain poorly understood. In addition to altering plant community composition, and thus suitability as wildlife habitat, rapid ecosystem transition also has major implications for carbon storage and feedbacks to climate. In the current study, we are using eddy-covariance technology to intensively monitor the land-atmosphere exchange of carbon, water and energy in a forested wetland near Milltail River to determine how net ecosystem carbon balance is affected over the short term by extreme storm events and over the long term by SLR. A new study extends the work by inventory of carbon in vegetation and soils of the major ecosystem types occurring across the Refuge, and characterizing hydrologic and salinity dynamics using groundwater table monitoring wells, with special focus on zones of vegetation transition and disturbed hydrology (e.g. near ditches). The new study will also use the RSET and isotope methods (Graham et al. 2005, Webb et al. 2013) to quantify rates of organic soil accretion or loss of the representative ecosystems, with the goal of identifying relative ecosystem resistance and vulnerability to SLR, respectively. Results will help inform Refuge management activities targeted at preserving wildlife habitat quality and protecting vulnerable ecosystem carbon stocks in the face of a rapidly changing climate and rising sea.

Carbon Emissions from Recent Peatland Fires

Robert Mickler, Division Manager, Alion Science and Technology Corporation, Durham, NC

Temperate zone (30 –50° latitude) peatlands store a large proportion of the world's terrestrial carbon (C) and are subject to high-intensity, stand-replacing wildfires characterized by flaming stage combustion of above-ground vegetation and long-duration smoldering stage combustion of organic soils. While severity, duration, and extent of peatland wildfires drives overall emissions, methods for assessing pre- and post-burn and above- and below-ground biomass, and accurately estimating C emissions have been poorly tested. Coastal peatlands are a unique region where long duration wildfire soil combustion is responsible for the majority of total emissions. We tested a method to estimate above- and below-ground C emissions from the Evans Road Fire and the Pains Bay Fire by combining burn intensity model output, field surveys, and remotely-sensed information. The approach to estimate below-ground C emissions employed pre-fire LIDAR-derived elevation coupled with post-fire survey-grade GPS elevation measurements. Above-ground C emission calculations were characterized for litter, shrub, and tree foliage fractions in different vegetation classes thereby providing detailed emissions sources. The estimate of wildland fire C emissions considered factors contributing to peatland emissions such as hydrologic regime, land management history, and remotely sensed estimates of vegetation damage.

Water Handling Operations in Peat Soil

Tim Craig. Fire Management Officer, Great Dismal Swamp NWR, Suffolk, VA

Hydrology and water handling are critical components to effective fire management in the Coastal Plain. Fire in the organic or peat layer—"ground fire"—poses serious challenges for fire suppression, cost and safety. Suppression efforts must include a water handling component when fires engage the organic soils. Ground fire and large scale water handling operations can be a challenging concept for personnel not familiar with working on organics. It is a specialized firefighting method that is not formally taught, and tends to be localized in practice. Capturing some standard operating procedures, understanding their implementation, and being able to communicate them, is critical for the local unit to both deal with smaller-scale incidents, as well as to provide guidance and assistance to incoming personnel to ensure effective and cost-efficient operations. This presentation will highlight some guiding principles and tactics to suppress peat fires using large volume water handling operations, and provide some insight into understanding fire in organic soils and developing and implementing a large-scale water handling operation.

Landscape Conservation Design in Eastern North Carolina and Southeastern Virginia

Pete Benjamin, Field Supervisor, Raleigh Ecological Services Field Office, Raleigh, NC

In 2006, the Fish & Wildlife Service endorsed Strategic Habitat conservation, SHC, as the adaptive management approach it would use to achieve its mission in the 21st unprecedented scale and complexity of challenges facing our natural resources, SHC strives to develop and implement landscape conservation that is more strategic, science-driven, collaborative, and adaptive. The five main elements of SHC are: (1) Biological Planning; (2) Conservation design; (3) Conservation delivery; (4) Outcome-based monitoring; and (5) Assumption driven research. With the intent of fulfilling the conservation design element, Landscape Conservation Designs serve as a partnership-driven method to assess current and anticipated future conditions, offer a spatially-explicit depiction of a desired future condition, and help provide management prescriptions for achieving those conditions on a broad geographic scale.

The Eastern North Carolina Southeastern Virginia (ENCSEVA) SHC Team is a partnership among local DOI agencies and programs with a mission to apply SHC to accomplish priority landscape-level conservation within its geographic area. In 2010, the Team embarked on a process to collaboratively develop a comprehensive Plan, provide biological planning guidance for its members, partners, and collaborators. This process established mutual conservation goals, objectives, strategies, and metrics to gauge the success of conservation efforts. Incorporating the expert opinions of wildlife biologists, ecologists, hydrologists, researchers, natural resource managers, and conservation practicioners, the resulting Plan will provide an approach to fulfill applied research needs, foster adaptive management principles, identify conservation priorities, prioritize threats (including potential impacts of climate change), and identify the required capacity to implement strategies to create more resilient landscapes.

Forested wetland communities are encompassed within several of the five environments targeted in this process (wetlands, riverine, estuaries, uplands, and barrier islands). Likewise, the threats of wildfire and invasives and the use of fire as a management tool to abate them, are identified in most. This presentation strives to share the underpinnings of this Plan, highlighting these foci, and encourage open discussion regarding knowledge gaps, implementation and monitoring of the resulting strategies.

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