MANAGING ATLANTIC WHITE CEDAR AT DARE COUNTY BOMBING RANGE: HISTORY, HOPES AND ASPIRATIONS

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Abstract--The North Carolina Chapter of The Nature Conservancy (TNC) and the North Carolina Natural Heritage Program (NCNHP), hereafter referred to as non-government organizations (NGOs); and other stakeholders have a strong interest in protecting and conserving Atlantic white cedar (AWC) forests present on Dare County Bombing Range (DCBR). Correspondence from the NGOs occurred, as draft forest management plans were distributed for public comment. During September 2003, Hurricane Isabel destroyed nearly 7,000 acres of forested ecosystems on DCBR, including 104 acres of mature AWC forest stands. An additional 112 acres of mature AWC was converted to hardwood forest types during the time period from 1989 to 2004. The Air Force sponsored a stakeholders meeting in September 2005 to address the hurricane damage, review the draft DCBR Forest Management Plan and renew communication between the DCBR natural resources staff and the NGOs. A series of meetings are planned to work toward consensus with the stakeholders on restoring the damaged AWC and future management goals of the AWC present on DCBR.

Keywords: Atlantic white cedar, NGO, The Nature Conservancy, North Carolina, Dare County Bombing Range, Hurricane Isabel, damage, management

INTRODUCTION

Dare County Bombing Range was established in northeastern North Carolina in 1964 to provide bombing and gunnery training for fighter pilots in the Air Force, Navy, Marine Corps and Air National Guard. DCBR is situated on a peninsula bordered by the Alligator River, the Pamlico Sound and the Croatan Sound, and is completely surrounded by the Alligator River National Wildlife Refuge, which is administered by the U.S. Fish and Wildlife Service (figure 1). Ordnance delivery and strafing are restricted to two impact areas; each area is approximately 2,500 acre in size. The balance of 42,000 acres is managed under ecosystem management principles in conjunction with multiple-use and sustained yield policies, in accordance with United States Air Force Instruction 32-7064 "Integrated Natural Resources Management" (USAF 2004).

Several species of concern occur within DCBR including the following animals (some protected): red cockaded woodpecker (*Picoides borealis)*, red wolf (*Canis rufus*), American alligator (*Alligator mississippiensis)*, and black bear (*Ursus americanus*). Dominant plant communities include Atlantic white-cedar *(Chamaecyparis thyoides)* and old-growth pond pine *(Pinus serotina)* forests. There are a total of 8,907 acres of AWC within DCBR. This forest community naturally regenerated following extensive clear-cut logging that occurred during the late 19th and early 20th centuries. The North Carolina Chapter of TNC designated the AWC on DCBR as a "globally rare Peatland AWC forest community" and, along with other NGOs, has a strong interest in protecting and conserving the AWC forests on DCBR.

HISTORY

In 1984, a cooperative agreement was signed between the Fourth Fighter Wing Commander at Seymour Johnson Air Force Base (AFB) and the NC Natural Heritage Program. This agreement registered 19,000 acres as Significant Natural Heritage Areas (figure 2). This agreement specified that there would be no change in title or loss of ownership rights by the Air Force; however, the Air Force agreed to limit any activities that would negatively impact those designated areas. At the time this agreement was executed, there was no forest management program

in place at DCBR. The Air Force established a forest management program in 1985, and communication between DCBR natural resources managers and the stakeholders has been sporadic over the years.

In 1992, the Department of Defense Legacy Resource Management Program provided multi-year funding authority to restore 3,000 acres of AWC ecosystems at DCBR and the adjacent Alligator River National Wildlife Refuge. The U.S. Air Force Air Combat Command provided additional funding from Forestry and Conservation programs. In order to achieve this complex and challenging goal, a steering committee was formed by representatives from the U.S. Air Force (USAF), Alligator River National Wildlife Refuge (ARNWR), North Carolina Division of Forest Resources (NCDFR) and North Carolina State University (NCSU), and the following tasks were identified: inventory remnant and cutover AWC stands, promote and enhance natural regeneration, develop seed and seedling sources, develop artificial regeneration methods, restore previously high-graded stands, implement a geographic information system (GIS), and establish water control and management to restore a more natural hydrologic regime. This eight-year, one million dollar project produced the most extensive and applicable information since the 1950s. Christopher Newport University, Newport News, VA produced a compendium on compact disk, which represents the current body of knowledge guiding AWC restoration efforts on DCBR (Belcher and others, 2000).

Daniels Consulting Forestry was contracted to perform a cruise of 1,261 acres of mature stands of AWC on DCBR (Daniels 1999). At the time of the inventory, Daniels found that most of the AWC trees were over 50 years old; some were up to 110 years old. Heart rot and wind throw were common in the older stands, especially those over 60 years old. The gross annual growth of AWC in the study area was estimated to be 607,000 board feet of saw timber and 727 cords of pulpwood. The AWC was not regenerating and was being replaced by lesser valued species (both financially and biologically) such as red maple (*Acer rubrum*) and sweet gum (*Liquidambar styraciflua*). Daniels recommended that the oldest AWC stands be harvested and regenerated back to AWC on a perpetual basis to prevent the eventual loss of this species.

Alion Science and Technology Inc. (1000 Park Forty Plaza, Suite 200, Durham, NC 27713) used orthorectified color infrared aerial imagery, GIS and three-dimensional heads-up digital photogrammetry to classify the vegetation on DCBR (figure 3). The vegetation was delineated at the Alliance Level of the national vegetation classification system as specified by the Federal Geographic Data Committee. A total of 8,907 acres of AWC were classified and delineated; these stands are comprised of 3,046 acres of pure AWC (forest stands with an AWC component of 75 percent or greater) and 5,667 acres of mixed AWC forest. Alion Science and Technology Inc. also compared color infrared aerial photographs to determine the extent of change in a contiguous stand of AWC on DCBR between 1989 and 2004 (Mickler and Bailey 2006a). The photographs were collected under leaf-off conditions on November 11, 1989 and on April 17, 2004. The photographs were converted to digital images, orthorectified and classified. The forest stand boundaries were digitized and plotted. Damage from Hurricane Isabel in 2003 was the most significant driver of change, converting 104 acres from mature-pure AWC forest to blowdown (figure 4). It is too early to assess regeneration in these areas. There were an additional 49 acres of pure AWC and 75 acres of mixed AWC forest types that were converted to predominantly hardwood forest types by 2004 (figure 5). The change in the stands of pure AWC stands that occurred during this same time period was also plotted (Mickler and Bailey 2006b). The 1989 stands (colored red) and the overlay of the 2004 stands (colored green) illustrate the loss of 151 acres of pure AWC shown in the map as the underlying 1989 red polygon areas (figure 6). Hurricane damage occurred in the interior of the stand, and loss of AWC by way of conversion to pine and hardwood occurred on the edges. The overall trends suggest a declining number of AWC trees, with a mixture of red maple, swamp black gum (*Nyssa sylvatica*), loblolly pine (*Pinus taeda*), pond pine (*Pinus serotina*) and bald cypress (*Taxodium distichum*) trees replacing them.

Former AWC stands that were clear-cut prior to Air Force ownership were inventoried and classified as to their relative stocking of AWC regeneration to determine their suitability for release (Van Druten and Eagle 2000). In 1998 and 1999, the Air Force hired a contractor to aerial spray 518 acres with Arsenal® herbicide. Arsenal® is a member of the Imidazolinone family manufactured by the Baden Aniline and Soda Factory (BASF). It is approved for release of AWC and may be applied on wetlands in accordance with Environmental Protection Agency regulations. During 2004, an additional 233 acres were sprayed for release. In 2006 Alion Science and Technology Inc. remeasured plots in an unsprayed control stand, the 1999 Arsenal® treated stands, and the 2004 Arsenal® treated stands to assess the success of AWC regeneration (Mickler and Bailey 2006c). The resurvey showed a substantial increase in hardwood competition and a decrease in AWC in the untreated control stand. The resurvey of the 1999 and 2004 Arsenal® treated stands showed an increase of AWC following hardwood herbicide application. Approximately 780 acres remain to be sprayed for release from hardwood competition.

The Air Force and Alion Science and Technology Inc. hosted a meeting in September 2005 of federal and state land management administrators and environmental groups interested in natural resources on the Dare County peninsula (Mickler and Bailey 2006d). The meeting brought together forestry experts from throughout the eastern U.S. to discuss historical, current forest management practices and restoration of AWC damaged by Hurricane Isabel. The meeting was attended by more than 50 people, including representatives from TNC, NCNHP, The Sierra Club, North Carolina Coastal Federation, NCDFR, the Southern Environmental Law Center and the U.S. Fish and Wildlife Service.

The main topic of discussion at the two-day meeting was the summary of comments provided to the Air Force on the draft Findings of "No Significant Impact" and the draft Environmental Assessment of the Supplemental Forest Management Plan for the DCBR. Attendees all agreed that the DCBR contained unique holdings of AWC that needed ecological management. The group discussed the first six of 44 comment items. There was some disagreement over what constituted AWC tree maturity. Some forest managers suggested a harvest rotation of 60 years, while some stakeholders preferred 200 years. Some NGOs objected to the proposed harvesting of old growth AWC and construction of new roads and ditches to access the hurricane-damaged stands because the hurricanes are a natural phenomenon and part of the ecological process, while some forest managers suggested that hurricane blowdown should be removed immediately to facilitate natural regeneration. It was agreed that further discussion was needed, preferably with smaller stakeholder groups.

Atlantic white cedar regeneration and harvesting sites on the DCBR were featured on the field trip on the second day of the meeting. One 32-acre stand of AWC blowdown was salvage logged during January 2005. On the day of the field trip, AWC seedlings were scarce. A seedling survival check performed in April 2006 showed an excellent survival rate of nearly 4,000 free-growing AWC seedlings per acre.

HOPES

Correspondence from the NGOs occurred, as Air Force draft forest management plans were distributed for public comment. During the past 18 years there have been misunderstandings and misgivings among the respective organizations. Differences in terminology also hindered communication between the DCBR natural resources managers and the NGOs. Examples of forestry terms and their corresponding ecology terms are listed in Table 1.

In April 2006, the DCBR natural resources management staff and Alion Science and Technology Inc. held a scoping meeting with the NGOs to discuss the DCBR Integrated Natural Resources Management Plan (INRMP) currently being drafted. After being presented with the most accurate vegetation map to date, the NGOs were open to redrawing the boundaries of the Natural Heritage Areas based on that map. The old boundaries seemed to have been based on anecdotal information and some old aerial photos, and are seriously in error. The NGOs recommended that the INRMP should include restoration and conservation of the AWC forest community as a high priority objective.

The Nature Conservancy has purported that if restoration and conservation of the AWC forest community are consistent with and supported by strategies for sustainable harvesting of AWC, then they can support such strategies. At the conclusion of this meeting, the Nature Conservancy representative stated he was pleased with the current relationship between the Air Force and TNC and the NCNHP, and that he thought we were all working toward the same goals.

ASPIRATIONS

With the advent of the 2004 color infrared imagery and recent vegetation classification accomplished by Alion Science and Technology Inc., we can now better manage AWC at DCBR. A forest inventory is planned which will provide a current description of the AWC community to include age, rate of growth and mortality. Our goals are to restore the AWC damaged by Hurricane Isabel, expand the presence of AWC by removing above-ground biomass and planting AWC seedlings, and aerial spray Arsenal® to release the remaining 780 acres of previously clear-cut AWC stands.

CONCLUSION

In the past, the DCBR natural resources managers and the NGOs seemed to hold opposing interests in what constituted proper management of AWC. We are now committed to working towards general consensus with the NGOs and other stakeholders on restoring and conserving AWC at Dare County Bombing Range and across the Dare County peninsula.

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Figure 1–Dare Country Bombing Range Location Map.

Figure 2--Current Natural Heritage Areas for the Dare County Bombing Range.

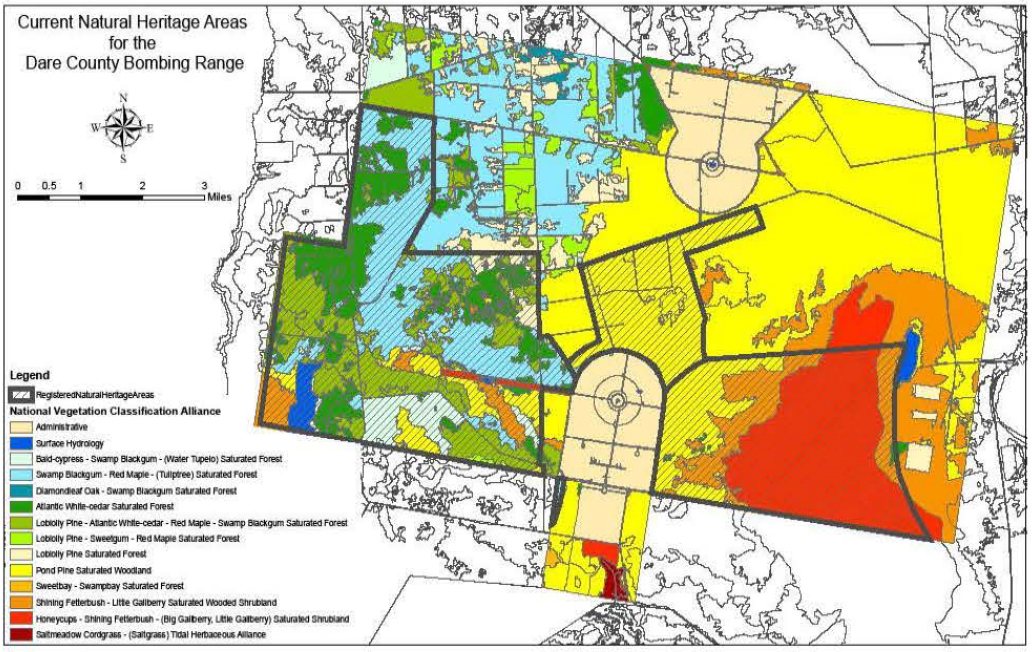

Figure 3--Dare County Range Vegetation Classification.

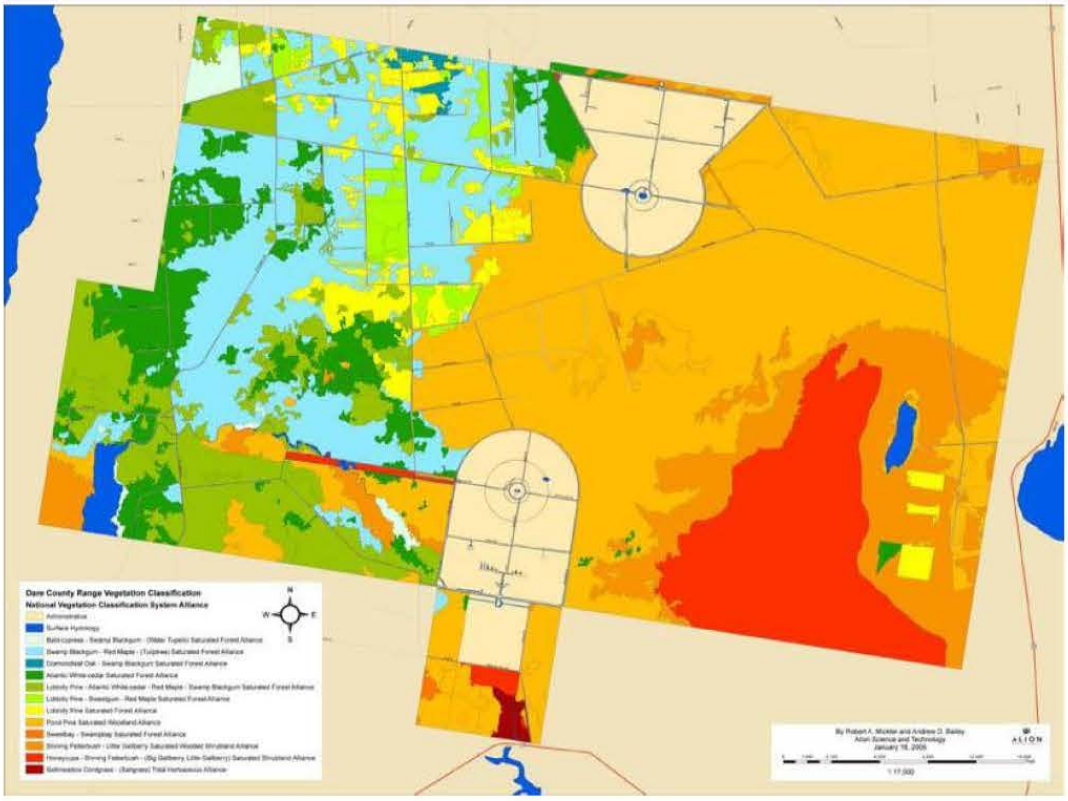

Figure 4--Extent of Hurricane Isabel Damage to Pure Atlantic White Cedar Stands.

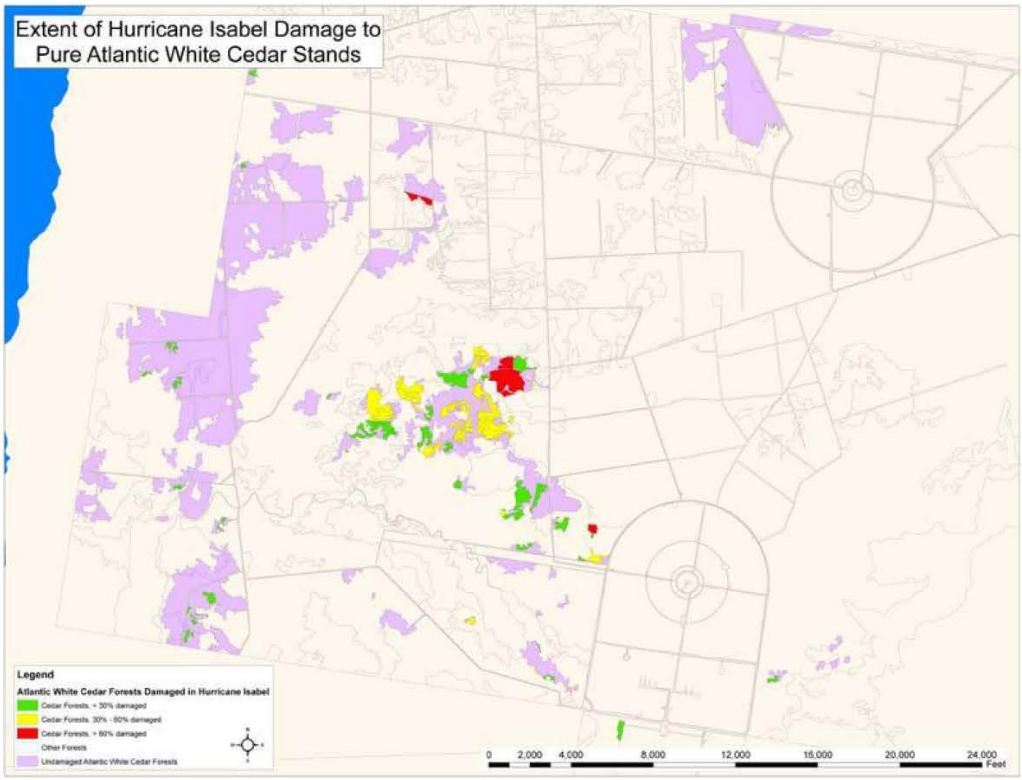

Figure 5--Change Analysis for Pure and Mixed Atlantic White Cedar Stands West of Beechland Road.

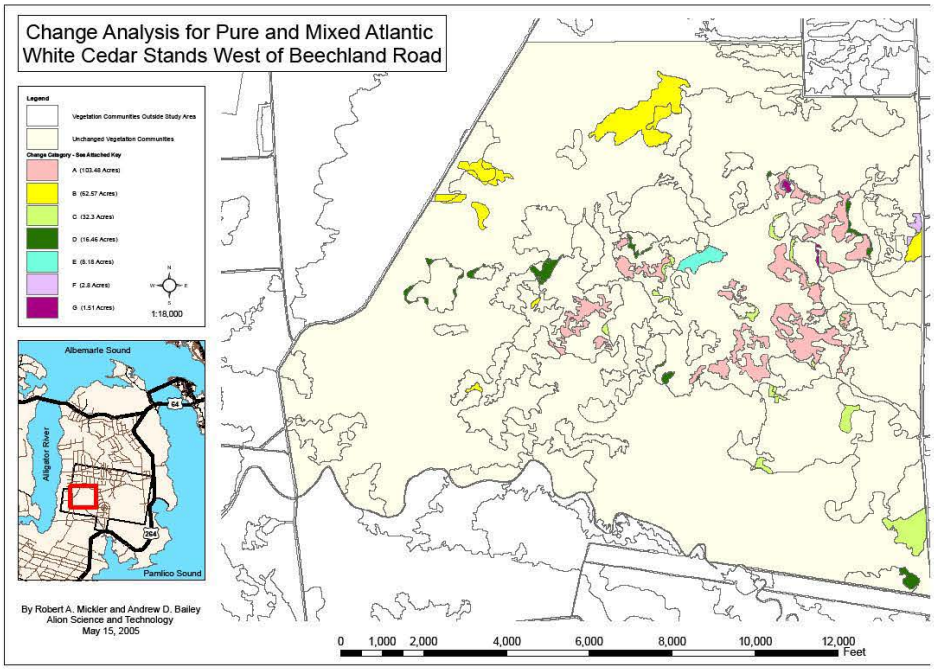

Figure 6--Change Analysis of the Pure Atlantic White Stand West of Beechland Road.

Table 1--Forestry Terms and Corresponding Ecology Terms

Forestry terms	**Ecology terms**
Forest type	Vegetation community
Rotation age	Life span of species
Board feet	Biomass
Net annual growth	Net primary productivity
Unmerchantable timber	Mixed hardwood forests
Forest stands	Large, small patches
Unmanaged stands	Biological diversity