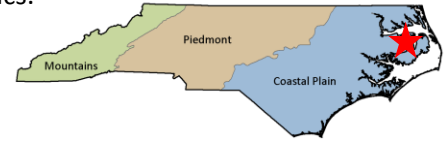


Demonstration Case Studies: NC Forest Service Stewardship Plans

Demonstration case studies provide examples of how the TACCIMO tool can be applied to support information needs. The following summarizes two cases in which state and private natural resource managers can utilize TACCIMO to identify effects of climate change and incorporate adaptive management principles into private forest management and stewardship plan objectives. Highlighted quotations from TACCIMO effects and management options are summarized with report selections identified in italics.

SMITH PROPERTY STEWARDSHIP PLAN – COASTAL PLAIN REGION



Property Location	Tyrrell County, North Carolina (Coastal Plain)
Property Description	Area 1: 60 acres in recently clear-cut loblolly pine on organic soils Area 2: 40 acres in 30 year old bay-dominated mixed hardwood forest
Primary Landowner Objective	“Keeping woodlands healthy and growing with minimal investment while still receiving occasional income from timber”

Climate Change Projections

Summarized Effects <i>-Tyrell County, NC</i>	The range of conditions projected by global climate models (Meehl et al. 2007) show that average temperatures in Tyrrell County, North Carolina could increase 2.5 to 4.3°F from historic conditions by 2050, or 4.1 to 5.9°F by 2090, while average monthly precipitation could increase 0.2 to 0.7 inches by 2050, or 0.3 to 0.9 inches by 2090.
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Objective: “Maintaining Forest Health”

Summarized Effects <i>-Forest Health -R8: Southern</i>	Future climatic conditions are expected to increase the range of destructive insects and diseases and amplify their impacts on forests (Dietze & Moorcroft 2011). Many forest pests, such as bark beetles, are limited by winter freezes, and with increased temperatures these species will be able to accelerate their life-cycles and cause increased damage (Tran et al. 2007). Increased water and heat stress on forests will additionally increase the risk of Southern Pine Beetle infestation (Gan 2004).
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Management Options	Reducing the overall density of woodlands through thinning and wider-spaced plantings will increase resilience to pest attacks by enhancing the health of forested stands (Chmura et al. 2011). Using sound management practices, including promoting a diversity of tree species and age classes, can enhance resistance to pest outbreaks (Galik & Jackson 2009).
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Objective: “Wildfire Concerns”

Summarized Effects <i>-Fire -R8: Southern</i>	The coastal regions of North Carolina are increasingly susceptible to spring and summer wildfires, and in the future the occurrence of wildfires is expected to increase (Joyce et al. 2008). Even with increases in precipitation, more frequent droughts and lightning strikes during the spring season may both contribute to an increase in the annual area burned (Heilman et al. 1998, Duncan et al. 2010).
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Management Options	Prescribed burning is an important tool that can minimize forest fuels; however, fewer safe burning days due to increased temperature and drought (Flannigan et al. 2000) may mean mechanical fuel removal and strategically-timed thinning may need to be considered in some cases (Finkral & Evans 2008). When using prescribed burning, the timing of the burns may need to be reassessed in order to minimize damage to crop trees, as the timing of spring bud-break in trees may change (Chiang et al. 2008).
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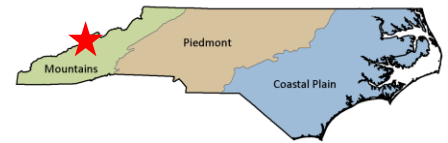
Objective: “Timber Management”

Summarized Effects
-Vegetation Management
-Growth and Yield

Timber resources will be affected directly by changes in carbon dioxide, temperature, and precipitation. Any increased timber growth in the future due to increased carbon dioxide levels could be offset by increased pressures for water and nutrients (Hyvonen et al. 2007). Heat stress might limit the growth of some southern pines (Woodbury 1998), while benefiting some hardwood species (Way & Oren 2010). Increased extreme weather events such as hurricanes, as well as disturbance from fire and forest pests, can also lead to a loss of timber (Joyce et al. 2008).

Management Options

Including adaptation to changing climatic conditions as a goal does not have to be cost-intensive. By using sound forest management practices that keep predicted future conditions in mind, landowners and managers can take actions which are beneficial now but also make woodlands more resilient to predicted threats (Halofsky et al. 2011). Planting a mixture of species, decreasing tree densities, modifying rotation lengths, and maintaining a prescribed fire regime are all practices that can help to mitigate likely increases in stress on forest trees (Cayan et al. 2006, Joyce et al. 2008).



JONES PROPERTY STEWARDSHIP PLAN –MOUNTAIN REGION

Property Location	Madison County, North Carolina (Mountains)
Property Description	Area 1: 45 acres in 50 year old natural white pine forest Area 2: 25 acres in 30 year old oak-dominated mixed-hardwood forest
Primary Landowner Objective	“Keeping the forest healthy while considering the impacts of climate change on the property’s wildlife and natural resources”

Climate Change Projections

Summarized Effects
-Madison County, NC

Boundary conditions projected by global climate models (Meehl et al. 2007) show that average temperatures in Madison County, North Carolina could increase 2.4 to 4.8°F from historic conditions by 2050, or 3.3 to 8.2°F by 2090, while average monthly precipitation could increase 0.2 to 0.3 inches by 2050, or 0.4 to 1.1 inches by 2090.

Objective: “Trout Fishing”

Summarized Effects
-Animal Communities
-Fish

Warming air temperatures and changes in stream flow associated with changes in rainfall will affect the abundance and distribution of fish species in the region. Altered stream flow patterns can lead to decreased water quality and disruption of spawning events (Pitchford et al. 2011). Cold-water adapted species, such as trout, will be the most vulnerable to population declines with future warming, while warm-water species may increase (Carpenter et al. 1992). In the southern US, future warming may restrict trout species to only high elevation streams (Flebbe et al. 2006).

Management Options

Landowners can help water-dependent species by identifying and maintaining streamside management zones (SMZs). Maintaining forest cover on land surrounding streams can provide shade essential for healthy water temperatures (Rahel et al. 2008), maintain water quality, and mitigate high-flow events which could harm juvenile trout (Wenger et al. 2011). Enhancing in-stream refuges such as deep pools and undercut banks provides an additional strategy (Mantua et al. 2010).

Objective: “Backyard Wildlife”

Summarized Effects
-Animal Communities
-Mammals,
Birds

Wildlife species will be affected by changing climates in different ways, depending on their requirements. Large mammals such as deer and bears might see a decreased need for food with warmer winter temperatures and an overall increase in population size from higher winter survival (Ayres & Lombardero 2000). Birds, on the other hand, could see decreases in population sizes as changes in food sources and heat stress along migration routes make movements more difficult (DeLeon et al. 2011). In order to adapt, arrival date and nesting times of some common birds may start earlier in the year (Torti 2005).

Management Options

Forest landowners should consider smaller scale but more frequent harvests in order to create a diverse mixture of different-aged forest habitat to support a wide range of wildlife habitats (Conroy et al. 2011). Increasing the health of current wildlife habitat through sound forest management techniques, such as prescribed burning on blocks of woodland that are rotationally burned, will help to “hedge your bets” against future changes (Evans & Perschel 2009). In addition, providing supplemental food or water sources during periods of drought may be beneficial (Bruzgul & Root 2010).

Objective: “Invasive Species Management”

Summarized Effects
-Invasive Species
-R8: Southern

The future climate is expected to favor invasive and aggressive species over native species (Joyce et al. 2008). Invasive plant species are expected to increase dramatically as their large range and tolerance of harsh conditions will allow them to rapidly move into new areas (Hellman et al 2008). Mountain regions will be especially vulnerable to upslope migration of invasive plants (McDougall et al. 2011).

Management Options

Forest landowners should be vigilant in treating invasive species breakouts as they occur, before those breakouts are too large to manage (McDougall et al. 2011, Joyce et al. 2008). Special attention should be paid to post-disturbance sites (e.g., after harvests, storm, or fire events), and native species should be promoted whenever possible (Funk et al. 2008).

Objective: “Maintaining Biodiversity”

Summarized Effects
-Animal Communities
-Amphibians

The forestlands of NC support a high level of biodiversity. The mountain region provides one of the state’s biodiversity “hotspots,” home to many sensitive animal species that occur at the southern limits of their ranges. Amphibians, known for their diversity in the region, may be the group most at risk under a changing climate, as many species rely on year-round moisture for survival (Wake & Vredenburg 2008). Climate change can affect these species through changes in the timing of breeding (Blaustien et al. 2001) and loss of suitable habitat (Milonivich et al. 2010).

Management Options

Landowners can help protect sensitive amphibians by reducing stressful conditions (Early & Saw 2011). Amphibians can be benefited by leaving piles of woody debris for cover to protect from high temperatures. Water sources, such as small seasonal ponds or wetlands, can be created to provide spawning habitats (Shoo et al. 2011). Canopy cover should be maintained at existing wet sites to reduce drying (Shoo et al. 2011).

TACCIMO is a web-based application integrating climate change science with management and planning options that connect land managers with peer-reviewed information they can trust. For more information, visit the TACCIMO tool

online: www.forestthreats.org/taccimotool

