Climate Change and Your National Forests

Forestlands across the region are experiencing increased threats from fire, insect and plant invasions, disease, extreme weather, and drought. Scientists project increases in temperature and changes in rainfall patterns that can make these threats occur more often, with more intensity, and/or for longer durations. Although many of the effects of future changes are negative, natural resource management can help mitigate these impacts. Management strategies informed by the best current science enable natural resource professionals within the Forest Service to better protect the land and resources and conserve the region's forestlands into the future.

Assessing the potential effects of climate change on Nantahala & Pisgah National Forests

Biological Diversity - Plants and animals at risk will respond to environmental changes by adapting, moving, or declining. Species with high genetic variation will be better able to survive in new conditions. Higher temperatures will cause many species to shift ranges, generally moving to track their suitable habit (e.g., north or up in elevation). However, in some cases, the rate of warming combined with land use changes will restrict the ability of plants and animals to move into suitable habitat. The species most likely to be negatively impacted by climate change will be highly specialized and habitat restricted.[1-6]

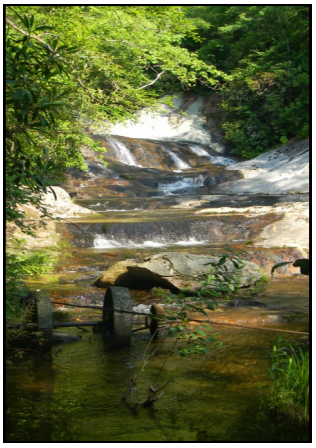
Forest Health - Invasive and aggressive plant and insect species may increasingly outcompete or negatively affect native species in the future. Winter freezes currently limit many forest pests, and higher temperatures will likely allow these species to increase in number. Destructive insects, such as bark beetles, will be better able to take advantage of forests stressed by more frequent drought. Certain invasive plant species, including kudzu, are expected to increase dramatically as they are able to tolerate a wide range of harsh conditions and already cover a large expanse, allowing them to rapidly move into new areas.[7-12]

Plant Communities - Changing temperature and rainfall patterns may threaten the survival of high-elevation communities in mountain forests. Rising temperatures will allow species from lower elevations to migrate up-slope, changing the forest communities seen today. Populations of species now existing on mountain peaks, including spruce-fir forests, will be most at risk in the future. Hardwood-dominated forests may experience stress from higher temperatures, allowing pines and other fast-growing species to become more dominant at the expense of slower-growing species such as hickories and oaks.[13-18]

Animal Communities - Wildlife species will be affected in different ways, depending on their needs. Amphibians may be most at risk, due to dependencies on moisture and cool temperatures that could be altered in a future climate. Populations of large mammals such as deer and bears may increase with warmer winter temperatures due to a higher winter survival rate. Birds, on the other hand, may decrease in population size as vegetation types change and heat stress makes migration more difficult. In order to adapt, arrival date and nesting times of some common birds may start earlier in the year.[19-24]

Populations of species now existing on mountain peaks, including spruce-fir forests, will be most at risk in the future

Water Resources - Shifts in rainfall patterns will lead to periods of flooding and drought that can significantly impact water resources. Increases in heavy downpours and more intense hurricanes can lead to greater erosion and more sedimentation in our waterways. Increased periods of drought may lead to decreasing dissolved oxygen content and poor water quality in some areas. Groundwater-fed wetlands such as high-elevation bogs will be particularly vulnerable to changing climate as temperature and rainfall changes have the potential to lower groundwater table levels, altering the length of time that wetlands hold standing water.[25-30]



Fish - Warmer air and water temperatures and changes in stream flow will affect the abundance and distribution of fish species. With higher water temperatures, fish communities in northern streams will begin to resemble communities in more southerly locations. Altered stream flow patterns can lead to decreases in water quality and oxygen content. Cold-water species, such as trout, will be the most vulnerable to population declines with future warming. The native brook trout may be most at risk, as warmer stream temperature and competition with invasive species will continue to reduce their populations.[31-35]

Extreme Weather - The potential for severe storms is expected to increase in the future, including more intense hurricanes making landfall in the southern US, with potential increases in flooding and landslides in mountainous landscapes. Conversely, extended periods of drought and forest stress may lead to drier fuels which will burn more easily and at hotter temperatures, and contribute to more and larger wildfires. More cloud-to-ground lightning due to warming may increase wildfire ignitions, even in mountainous areas where fires are historically less common.[36-41]

Recreation - Environmental changes may negatively impact recreational experiences due to changes to the plant and animal communities that make those recreational experiences unique, along with an increase in haze that may reduce the visibility of mountain views. While more days above freezing could increase use in some forest areas in the cooler seasons, more days with extreme heat could decrease use in the summer if temperatures impact visitor comfort. The fall foliage season may be affected as leaves change color later in the season and increasing stresses on forests impact the vividness of fall foliage displays.[42-46]

MANAGEMENT IMPLICATIONS

Management activities provide national forests with an opportunity to reduce the susceptibility of their resources to multiple threats, including drought, invasive species, disease, and wildfire. Adaptation to climate change as a management goal may provide multiple benefits. By using sound natural resource management practices that keep predicted future conditions in mind, the Forest Service can promote the immediate and long-term health of its forests. Specific approaches vary with site and species of concern, but examples of adaptive strategies include:

- Manage tree densities where needed through sound forest management practices to maximize carbon sequestration while reducing the susceptibility of forest stands to water stress, insect and disease outbreaks, and wildfire.[47-50]
- Focus restoration efforts in cove forests where cool microclimates buffer the effects of future warming and water stress.[51]
- Maintain piles of natural woody debris and promote wetlands in areas of high amphibian diversity to supplement habitats that retain cool, moist conditions.[52]
- Monitor for new invasive species moving into areas where they were traditionally not found, especially in high-elevation communities.[53]
- Enhance riparian corridors to provide shade to moderate increases in water temperature and stream flow that could decrease water quality and harm native trout populations.[54]

Adaptation to climate change as a management goal may provide multiple benefits

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Climate Change and Your National Forests: Citations

Information in this factsheet is summarized from 54 peer-reviewed science papers found in the USDA Forest Service's TACCIMO tool. TACCIMO (the Template for Assessing Climate Change Impacts and Management Options) is a web-based application integrating climate change science with management and planning options through search and reporting tools that connect land managers with peer-reviewed information they can trust. For more information and the latest science about managing healthy forests for the future visit the TACCIMO tool online: **www.forestthreats.org/taccimotool**

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