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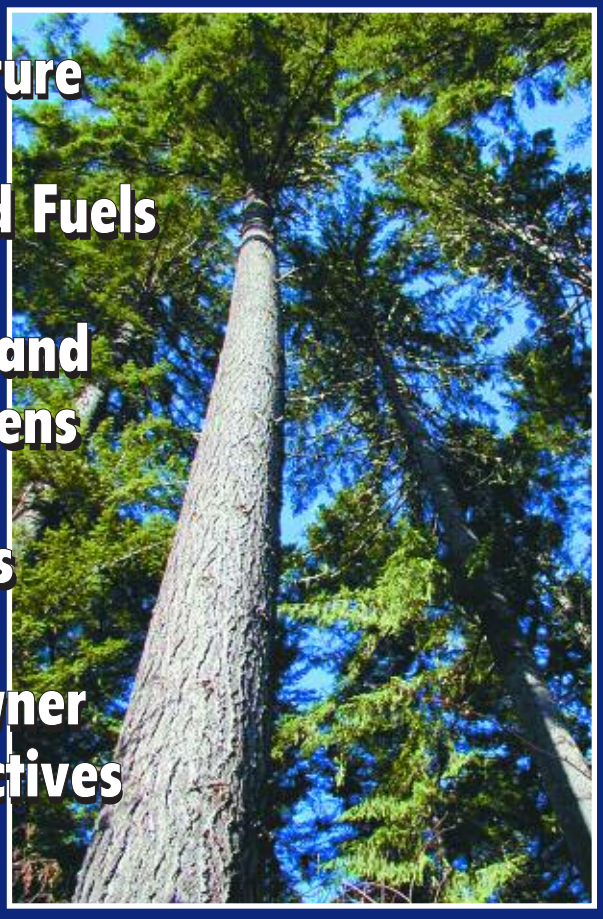
Northwest Woodlands

A Publication of the Oregon Small Woodlands, Washington Farm Forestry, Idaho Forest Owners & Montana Forest Owners Associations

DOUGLAS-FIR OR SAGUARO CACTUS?

Managing Forests for Potential Climate Change

- Silviculture
- Fire and Fuels
- Insects and Pathogens
- Genetics
- Landowner Perspectives



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Forest Energy and Residue Markets

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TABLE OF CONTENTS

Spring 2010

FEATURES

DEPARTMENTS

ON THE COVER:

Climate change and its potential impacts to forests in the Northwest is the topic of this issue. This is a photo of a 95-year-old Douglas-fir on Starker Forests property.
Photo courtesy of Rick Fletcher.
Cactus photo courtesy of istockphotos.com

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Climate Change and the Woodsman

By MICHAEL FORTUNE AND PHILIP MOTE

Michael Fortune

Philip Mote

Media coverage of global climate change can veer between describing it as a catastrophe and a hoax. Several basic facts get lost in the noise though: Climate has always changed, laboratory experiments show the profound effect of carbon dioxide (CO_2) on infrared energy transfer through air, and human activities (chiefly burning fossil fuels like coal, oil and natural gas) have raised atmospheric CO_2 concentrations by 40 percent since 1850 to levels not experienced since several million years ago. The basic physical fact that CO_2 and other "greenhouse" gases absorb infrared energy implies that a 40 percent increase should lead to measurable warming. But can we discount the hypothesis that the 20th century increase in global mean temperature of 1.1°F is purely natural?

While earth's climate has always fluctuated, most of the large fluctuations in global temperature were produced by changes in solar energy or greenhouse gases. Disentangling human and natural causes requires considering all causes in a rigorous statistical framework, and nearly every study that has done so recently has found that most of the warming since the mid-20th century was produced by the increase in CO_2. The continuing increase of CO_2—likely to reach two to three times preindustrial levels by 2100—means that the 21st century will see a transition in climate to something quite different from recent experience. In the Northwest, some predicted changes are already underway: a warming of about 1.5°F in the 20th century, hydrologic changes related to reduced spring snowpack, and increased forest growth at high elevations.

Woodsmen may anticipate some benefits from climate change, including faster tree growth in the future when levels of CO_2 and nitrogen oxides will be higher. But there are many detrimental effects, too. Insect pests will have an advantage in western forests under a warmer climate. Wildfires, already a growing menace, will become more widespread than current fire regimes as Northwest summers become hotter and drier and spring snowpack continues to shrink.

Benefits of 21st century climate

In the past 20 years, U.S. forest productivity has increased two to eight percent. Scientists have considered several possible factors including rising temperatures, rising CO_2, changes in precipitation, more disturbances, more availability of nitrogen and other sources, but the causes cannot yet be disentangled. Rising levels of CO_2 in the air will increase productivity of forests IF sufficient water and nutrients are available, but that is not assured. In a variety of experiments, productivity increased an average of 23 percent when levels of CO_2 were boosted to the levels expected in 2050, but in some experiments the additional productivity only lasted a few years.

Storing carbon in your woodlands

Actively growing trees consume CO_2 from the air, including extra CO_2 released by use of fuels, deforestation and other human activities. Trees store the carbon in wood, sap, roots, nuts and leaves. The massive amount they store may surprise you: Forest growth in this country currently offsets 20 percent of the annual emissions of CO_2 from use of fossil fuels in the U.S. The oceans absorb at least as much. This is a great service nature is providing: one that offsets more rapid climate change because only about one-half of the CO_2 released by burning fossil fuels remains in the atmosphere. But CO_2 remains up there for 100 years or more, where it continuously traps heat in the atmosphere.

Does harvesting timber add substantially to the CO_2 in the atmosphere? It depends on what happens to the wood. Wood that is cut for forest products retains its carbon in solid form for decades or centuries, which is as good as wood on the tree. If wood is used to make paper, its carbon is burned up or decomposes in landfills, and it soon re-enters the atmosphere as CO_2 (unless the paper is recycled into new products, of course).

Impact of Northwest climate change on forests

As mentioned earlier, the Pacific Northwest warmed about 1.5°F in

the 20th century. It may not seem like much change, but our new climate has many more warm days, and in the Pacific Northwest at least, many more dry years than before. Severe droughts are becoming more common in most of the western U.S. A change in the pattern of sea surface temperatures in the Pacific Ocean combines with general warming around the globe to increase the likelihood of drought in the Northwest.

Two consequences of climate change today are troubling for the region's forests: fires are more extensive and more destructive; and insect pests are causing more forest die-offs, both by expanding their ranges and by taking advantage of changing conditions within their ranges.

PHOTO COURTESY OF LORRAINE MACLAUCHLAN, MINISTRY OF FORESTS, SOUTHERN INTERIOR FOREST REGION

An aerial view of extensive attack by mountain pine beetle in British Columbia, Canada.

The occurrence of wildfires has increased substantially since the mid-20th century, as has the length of the summertime fire season. These changes result in part from the trend toward earlier snowmelt, which allows the soil to dry out earlier in the hot summer season.

There are several lines of evidence that wildfires have become more frequent and extensive in the western U.S., and that these changes result from warming of the climate. Studies of tree rings going back several hundred years confirm this link. In addition, fire severity has increased in drier forests partly because of fire suppression policies. Warmer and drier periods in the past 1,000 years also had more frequent and severe wildfires.

Simulations of climate in climate models lead us to expect more days of the year having humidity sufficiently low that a fire alert would have to be put out. Analysis of past data combined with projected future climate trends suggest that burned area in the Northwest will likely at least double during this century. Other studies suggest the frequency of wildfires would double in boreal forests (the spruce and fir forests of the far north). In Alaska and Canada, burned acreage more than doubled between the 1960s and the 1990s.

Climate and insect pests

Insects now cause about $1.5 billion in annual damage to forests in the United States. Several insects that cause problems in the western U.S. are discussed below.

• The western spruce budworm is the most destructive defoliator of coniferous trees in Western U.S. forests.

• The mountain pine beetle attacks lodgepole, ponderosa, sugar and western white pines in our region. About 17 percent of the whitebark pine in the ecosystem of the Greater Yellowstone region has been infested by this beetle, and this beetle has also killed over 100 billion board feet of timber in British Columbia in a massive outbreak over the past decade.

• The western pine beetle has been attacking ponderosa pines in the Cascade and Northern Rocky

–Continued on next page–

Climate Modeling

Global climate models are very large computer programs that use quantitative methods to simulate the physical interactions of the atmosphere, oceans, land surface and ice. They are used for a variety of purposes from study of the dynamics of the climate system to projections of future climate.

All climate models take account of incoming solar energy and the heat (or infrared) energy emitted by the surface of the earth. Flows of heat in air currents, condensation and evaporation are all represented, along with many complex processes like cloud formation. With a typical global model, an interactive ocean and atmosphere can produce realistic-looking climate fluctuations like tropical El Niño events. These models have been extensively compared with observations, and the surface temperature variations associated with seasonal cycle, with volcanic eruptions, and with natural modes of climate variability all look pretty realistic.

Scientists perform many experiments with climate models; for example, trying to figure out what role certain areas of the ocean may play in influencing drought in the western U.S. Perhaps the most important experiment, though, is the one we are conducting on our planet (with no "control" case): What happens if we double or triple the amount of carbon dioxide? Most models suggest a global increase in temperature of 5°F or more for a doubling of CO_2, with substantial changes in precipitation patterns and other important aspects of climate.

Mountain ranges for some time, usually targeting stands of a single tree species.

• The Douglas-fir tussock moth causes occasional heavy mortality among Douglas-firs.

The onset of drought or any other moisture stress causes previously healthy trees to be susceptible to attack by western pine beetles. Healthy trees with access to water produce copious amounts of sap or resin, which flows out through sites where beetles have drilled through the bark. In a wet summer, the tree can successfully defend its tissues from attack by insects. During a drought, the tree produces insufficient amounts of sap to deter the insect invaders.

Regional warming and the associated shift in climatic zones would expand the range of many of these insect pests into more northern forests and higher-elevation stands. Foresters are concerned that the mountain pine beetle may expand its range north into stands of jack pine, considered a suitable host for this pest. If that happens, the beetle can spread across the continent as jack pine is widespread in the boreal forests of Canada.

Finally, winter cold has checked the spread and outbreaks of many insect pests. The hemlock wooly adelgid, an exotic (non-native) true bug, is rapidly destroying hemlock forests in the eastern United States. Since it lives through the winter, this insect is checked by frigid temperatures on the northern limit of its range. It is an example of many insects whose range is limited by climate. As warming occurs in the west, the range of many pests is expected to expand northward and also to higher elevations than we have observed so far.

Other pollutants

Nitrogen oxides are released by automotive emissions and are produced in urban smog. Even though it has many deleterious effects on health and ecosystems, nitrogen oxides appear to have a beneficial effect on forests. Nitrogen deposited by rainfall acts as a fertilizer, and one report of the Climate Change Science Program noted that there is "strong evidence that the effects of nitrogen deposition on forest growth and carbon storage are positive, and may exceed the effect of higher levels of carbon dioxide."

Changes in composition of species

One effect of climate change is almost certain, though the way it will be manifested is difficult to predict: The composition of tree species in forests will almost certainly shift. What we have learned from the study of the geological history of pollen composition from lake sediments is that new species will arrive, other species will decline, and novel ecosystems will emerge. Looking into the future, one combination of ecological and climate models (the Mapped Atmosphere-Plant-Soil System) predicts that the area of wet conifer forests of the Northwest decline by some nine percent and montane forests expand into formerly alpine meadow ecosystems.

One review of 866 scholarly papers on the ecological consequences of climate change found that 60 percent of the 1,598 species that were studied shifted their distributions in the 20- to 140-year time period of the study.

Parting thoughts

The reality of an emerging human influence on global climate has been confirmed by hundreds of peer-reviewed studies and disputed by only a few. Best estimates of future warming for the Northwest are in the neighborhood of 5°F during this century, with summers becoming drier.

Whether or not the experts turn out to be right, the prudent course is usually to consider what to do if they are. In the case of forest managers, this prudent course can include minimizing the risk of severe fire and minimizing the risk of insect outbreaks. What the specific actions are to minimize these risks depends on the type of forest, the local climate and other factors. Within a year or two, Oregon Climate Change Research Institute and state forestry agencies may have better guidelines for climate adaptation. ■

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For Further Reading

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