Responses to Questions for the Record
Following the September 24, 2007, Hearings
by the Senate Committee on Energy and Natural Resources
from Dr. John A. Helms
October 3, 2007

Questions from Senator Ken Salazar

1. What types of adaptation management strategies have been found to best deal with managing the expected increased threat of wildfires?

Wildfires require a combination of fuel, temperature, and oxygen. Of these, the only factor that can be managed is the presence and distribution of fuels. Given that the most intense and catastrophic fires occur in dense forests, and since experience has shown that when wildfires encounter less dense and more open stands fire intensity commonly drops (USDA PSW 2007), it seems clear that increased efforts must be made to thin overly-dense stands. In doing so, irregular mosaics of stand density should be created that remove ladder fuels to reduce opportunities for fire to burn into tree crowns.

Since it is clearly impossible to rapidly treat all 180 million acres the Forest Service estimates are in hazardous condition, current efforts to create "Defensible Fuel Profile Zones" (DFPZs -- Quincy Library Group/USDA FS, California), "shaded fuelbreaks" (Agee et al. 2000) and "Strategically Placed Landscape Area Treatments" (SPLATS or SPOTS in California's Sierra Nevada -- USDA FS) are all worthwhile exploring. These are areas 1/4 - 1/2 mile wide, usually along roads or strategically placed in which fuel loadings are reduced to reduce potential for crown fires, interrupt fire spread, and to provide defensible space to fight the fires.

Although not free from criticism, these efforts are initial steps in the right direction. More adaptive management and pilot studies (such as the Fuels Management National Pilot Project 2007 funded by the Forest Service) are needed to demonstrate efficacy and cost effectiveness and to communicate lessons learned from these and other projects and forest treatments (Wildland Fire Lessons Learned Center 2007).

2. One of the most enduring ad campaigns in our country's history are the Smokey the Bear public service announcements. There probably isn't a person in the room who hasn't heard the slogan "Only you can prevent forest fires." Given that the majority of wildfires are caused by human activity, are there plans to increase efforts to reach the public on climate change and expected increased wildfire activity, and ways to prevent wildfires?

There is considerable current effort aimed at providing the public with information regarding wildfires, hazardous fuels, and the need to provide defensible space around homes. Some of these are the *Fire Safe Council*, *Firewise*, *Rural Fire Assistance*, and *Landfire*. National programs are coordinated through the *National Fire Plan*. Fire-prone states such as California have aggressive programs of public information.

However, the fact that catastrophic wildfires are due to hazardous fuel loadings and over-dense public forests and thus can be addressed by forest management seems to be either little understood or rejected.

Increased effort in technology transfer and outreach is needed, particularly at K-12 education levels where perceptions are formed, to provide the public with science-based information regarding the need to restore public forests to densities that do not support catastrophic, stand-replacing fires or insect outbreaks. It is generally not appreciated, for example, that current mature mixed conifer stands in the Sierra Nevada of California are carrying over 1,000 trees per acre; by comparison, natural forests in which low-intensity fires were common carried only about 40 mature trees per acre.

Priorities to move forward are: 1) enhance collaboration among federal and state agencies in partnership with industrial, tribal, and non-industrial family forest owners, 2) streamline legal and regulatory frameworks to encourage restoration of forest health and responsible stewardship of the nation's forest lands, and 3) provide better communication to the public and decision makers indicating that restoring and maintaining forest health is key to mitigating likely effects of climate change.

3. The link between climate change and fire is clearly strong, but since this linkage has come to light, some people suggest that climate is more critical than fuel as a driver of fire behavior, and there is no reason to treat fuels to protect communities or restore ecosystems. What are the implications of climate change for fuel treatment and forest restoration?

Wildfires are driven by both fuel and temperature and are made particularly devastating when combined with low humidity and high winds. Modeling shows that, in general, changing climate will likely result in more wildfires. However, fires won't burn without fuel, and fire intensity increases with fuel loading. A prudent steward of forest lands would therefore reduce hazardous fuel loads and remove a portion of trees that provide ladder fuels that enable flames to reach the canopy.

The amount of fuels in a forest can reach 15-70 tons per acre (Sampson 2004) and this fuel loading cannot be removed by prescribed burning without incurring substantial risk. Therefore some preliminary mechanical treatment is required. This could be cost-effective if the smaller-dimension biomass could be used for cellulosic ethanol production and the larger material converted into wood products that store carbon. A major hurdle on public lands is to make this material available through long-term contracts that provide a sufficiently stable investment climate that will enable industry to construct the necessary processing plants for both ethanol and wood products.

4. Fires are becoming increasingly harder to fight and are releasing huge quantities of carbon dioxide. Wildland Fire Use, the practice of allowing some lightning-ignited fires to burn under less extreme conditions, has been suggested as a way to mitigate fires and ensure they release less carbon dioxide. Do you see a role for Wildland Fire Use in changing future fire behavior so it is less extreme, thereby releasing fewer greenhouse gases?

Yes, the *Wildland Fire Use* system in which lightning fires are managed to achieve resource benefits is a worthwhile approach to reintroducing natural fire into forest ecosystems. Wildfires are indeed increasingly hard to fight and release 75-80 tons CO_2 or more per acre (Sampson 2004). Fires that can be several hundred thousand acres in size are clearly emitting millions of tons of CO_2 and other greenhouse gases into the atmosphere. Once forest stands are restored to more natural density levels, prescribed fires can be used which emit about 18-20 tons CO_2 per acre (Sampson 2004).

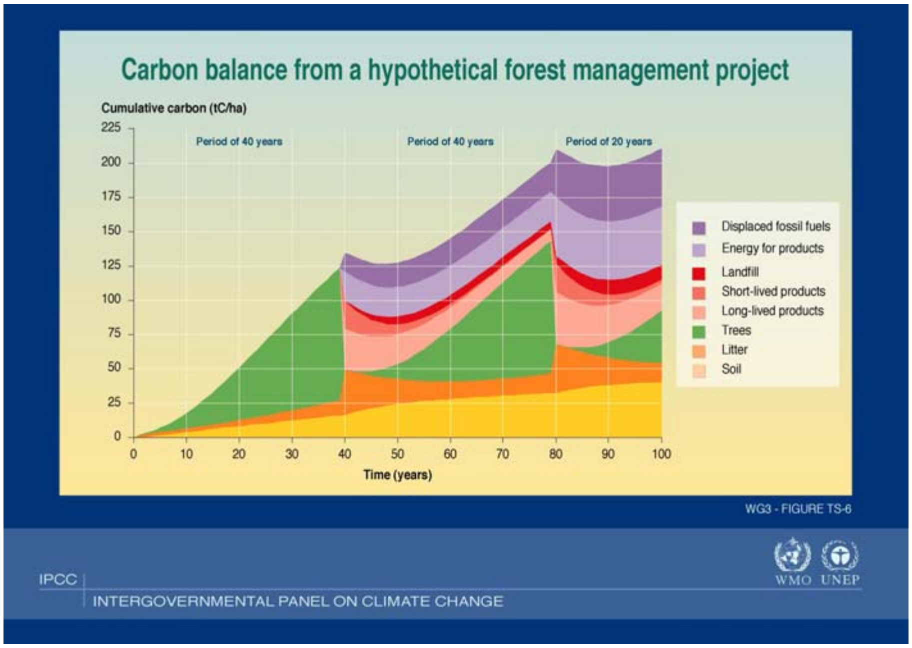
Decisions to permit natural fires to burn are based on diverse criteria that assess the risk to private property, ecological systems, and societal values. The *Wildland Fire Use* approach is commendable, however one must accept the likelihood that, initially at least, some ecological and societal values will be damaged and air quality will be affected. This points to the importance of providing the public with quality information regarding the goals, risks, and benefits of the program.

5. It has been suggested that because young forests grow fast and older forests grow slowly we can cut down old forests and replace them with fast-growing plantations to maximize the uptake of carbon dioxide and reduce global warming. What is the current scientific understanding of the effects of logging older forests on the uptake or release of greenhouse gases?

It is true that fast-growing, younger forests sequester carbon at a higher rate than slower growing, older forests. When older forests become mature or over-mature, the rate of carbon accumulation may become zero or negative due to loss of vigor, tree mortality and decay of organic matter. The total accumulation of carbon in older forests is greater than in younger forests.

It is well documented, however, that young forests managed by utilizing a series of harvests will, in time, sequester or store more carbon than unmanaged forests left for several hundred years (Birdsey and Lewis 2002, Krankina and Harmon 2006, IPCCa 2007). This is because, over successive rotations or cutting cycles, managed forests maintain high rates of CO_2 uptake. The superiority of managed forests in sequestering carbon is especially evident when the harvested wood is used for both energy production and wood products that store carbon for long periods. The situation is made even more compelling when renewable wood products are used instead of alternative materials such as concrete, steel, aluminum, and plastic that are non-renewable and have been shown by life cycle analyses to consume far higher amounts of energy in manufacture (Perez-Garcia et al. 2005). In this context it should be mentioned that "managed forests" are not necessarily single-species, uniformly-spaced "plantations". They could be if this was desired, but they could also be managed to have multiple species, several age classes, and understory vegetation such that are indistinguishable from naturally-occurring forests.

The following figure from the IPCCa 2007 report illustrates the principle.



From: IPCCa, 2007

Forests and forest management have an important role in mitigating climate change. As reported by the Intergovernmental Panel on Climate Change (IPCC 2007b):

> "Forestry can make a very significant contribution to a low-cost mitigation portfolio that provides synergies with adaptation and sustainable development. However this opportunity is being lost in the current institutional context and lack of political will and has resulted in only a small portion of this potential being realized at present (*high agreement, much evidence*)."

Questions from Senator Pete Domenici

You have testified that ". . . in general, effects of climate change are more likely to be seen in northern latitudes with loss of meadows, conversion of forest to grassland, and tree invasion into areas that were previously too cold. Forests are expected to move north in latitude and upward in elevation. Pine forests at low elevation are likely to be replaced by woodlands and grasslands." Dr. Swetnam suggested that it might be too late to manage in high-elevation long fire rotation stands and that it might be wiser to focus management in the Ponderosa Pine forests of the Southwest.

6. If the low elevation and southern Ponderosa Pine forests are likely to migrate to higher elevations and to the north, as suggested by Dr. Swetnam, do you believe it would be wise to ignore the fires at higher elevations in the northern Intermountain States?

Decisions on when and how to deploy fire suppression resources depend on professional analyses of potential fire behavior, duration, cost, and risk to ecological, environmental, and societal values, life, and property. This approach is appropriate when considering fires within any ecosystem or biome. The mountain tops of the Southwest are especially at risk to climate-induced vegetation changes and replacement by species that are more adapted to hotter and drier conditions. Thus these unique ecosystems may warrant special attention to reduce the likelihood and severity of wildfires.

7. What does the field of forestry tell us about the ability of tree species to invade and reforest lands that have been heavily impacted by fires, including the loss of soil and the changes in moisture regimes after high intensity fires?

In general, rates of germination, establishment, and growth of trees after wildfires are slower than those of shrubs and grasses -- in particular sprouting shrubs and hardwoods. It is therefore common for pioneering shrubs and grasses to rapidly colonize and dominate burned areas for many decades. This is less true for the "fire-type" conifers such as lodgepole pine that have serotinous cones evolved to open from the heat of fires. Forestry research and experience shows that vegetation growth after fires varies from brushfields to successful tree regeneration depending on such factors as the availability of seed. Surveys in California's Sierra Nevada have shown that mature true fir forests having no shrubs in the understory can have 2 million viable seeds of shrub species per acre that remain dormant in the soil until heat from fires cracks their seed coats and stimulates germination. In contrast, tree seeds do not commonly remain viable in the soil after two years and seed crops have periodicity from one to seven years.

After a wildfire, a prompt assessment is needed of post burn conditions to determine the likelihood that desired vegetation of diverse species will become established. The desired mix of vegetation cover needs to be defined and the timeframe in which preferred conditions of tree cover, habitat, and soil cover should be attained needs to be identified. Experience has shown that those areas likely to become brushfields or have high potential for erosion need to be promptly planted to return them to forest conditions. Brushfields often have conifer seedlings underneath them, but it can take 50-100 years for the trees to overtop the brush and form a forest canopy. Burned areas that may regenerate satisfactorily to the desired species mix without treatment or are ecological reserves not needing treatment should be identified in the post-burn assessment.

In all cases, the post-burn analysis should identify the costs, benefits, and risks associated with action or no action. Decisions should ensure that society is best served by using treatments where necessary to rapidly restore the preburn mix of forest values, habitats, uses, and watershed protection.

8. Dr. Helms, you have also testified that "…since both growth and mortality on national forests greatly exceeds harvest resulting in a build-up of fuels, it would be prudent to consider treatments and incentives aimed at fuel reduction and using excess biomass . . ." In your estimation, what type of effort would it take to mitigate the potential impacts of the change to our forests that you and the other witnesses have suggested could happen? That is, how can we prepare those forests for the changes that may occur?

Efforts are already being made by agencies within Interior and Agriculture under existing programs and policies such as the Healthy Forests Restoration Act of 2003 to reduce fuels that have built up in over-dense federal forests. However, current efforts are small relative to the magnitude of the problem. The main impediment to progress is that segments of the public distrust and challenge analyses and plans to thin forests. To prepare forests for climate changes, emphasis must be placed on identifying ways and means by which high-risk stands and forests can be thinned and fuel reduction carried out to restore and maintain forest health and vigor in a societally-acceptable manner.

The Forest Service estimates that 180 million acres of national forests are in need of treatment and all this area cannot be readily treated in a short timeframe. However, the spread of catastrophic wildfires can be limited by shaded fuel breaks such as described in my response to Question 1.

In 2006 a joint agency comprehensive fuels treatment strategy was initiated aimed at reducing fuels buildup in forests in an efficient and effective manner (USDA and USDI 2006). This mix of policy and management approaches is an important step and warrants enhanced support and further development.

9. Do you recommend we start now, or do we have time to fight and fuss over what environmental protections and analysis must be completed before we begin to take action?
Because wildfires are increasingly devastating and costly there is an urgent need to address forest condition problems and societal impediments to mitigation. This task has already commenced and excellent programs are beginning to reduce fuels on public lands (e.g., USDA and USDI 2006, National Fire Plan 2007). About 20 million acres have already been treated under the Healthy Forest Restoration Act, with special emphasis on the wildland/urban interface. But accomplishments to date represent only a small fraction of the 180 million acres of national forests needing attention, thus losses to catastrophic wildfire and costs of suppression are increasing. Overly-dense national forests need to be thinned, which would not only reduce hazards of wildfire but would also enhance wildlife habitat and water yields.

National forests are owned by the people who necessarily must have a say in how their forests are managed. In addition, treatments under any policy or plan must conform with current laws and regulations. To address controversy and opposition by some segments of the public to thinning public forests, increased efforts are needed to provide factual information through technology transfer such that children, adults, and decision makers have adequate science-based information to help shape opinion regarding the balance that needs to be struck between competing uses and values of forests. This is especially important in the context of climate change because the likely increases in forest mortality and wildfires are undoubtedly going to negatively impact the diverse benefits that forests provide society.

Moving forward will require policies and incentives aimed at increasing collaboration among landowners and stakeholders such that sustained thinning projects can be developed at the scale and duration necessary to effectively address the wildfire problem.

10. Dr. Helms, during questions by Senator Tester, you suggested that timber management could help to maintain sufficient crown cover to help hold the accumulated snow pack in place for longer than in open areas. If trees sometimes have a more difficult time regenerating after high intensity fires and water retention and run off are negatively impacted in the absence of tree cover; and we do experience higher temperatures, are we more likely to see brush fields, or stands of new trees as species have to migrate up in elevation and to the north through these heavily burned lands?

Maintaining and enhancing the nation's water supply for residential, agricultural, and environmental needs is a critical priority. The nation's future supply of water is in jeopardy in the context of changed climate and precipitation patterns, particularly in the Southwest. Most of the nation's water comes directly from forested watersheds or indirectly through recharged ground water systems. It is imperative, therefore, that forests be evaluated in terms of how their structure and composition affect hydrological cycles and the extent to which management can enhance the supply and quality of water and the timing of distribution to streams.

Where precipitation is in the form of snow, forest cover is critical in enhancing water yields by providing shade over snow, delaying snow melt, and preventing erosion. These effects are enhanced where the forest has a discontinuous canopy cover, a condition that may have to be maintained by thinning.

Given likely higher temperatures, uncertain precipitation patterns, and possible species change, it would be prudent to examine whether thinning treatments can maintain forest health, delay transition to better-adapted vegetation such as shrubs, and thus help ensure adequate water yields for environmental and societal needs.

The potential of forests to revert to brushfields, either following wildfire or as the result of climate change, is important because once an area is dominated by brush it often takes many decades before trees can break through and the area returns to forest. As brushfields commonly reburn, the area can remain dominated by brush indefinitely. The importance of considering ecological succession and forest/brush dynamics in any management strategy is mentioned in my response to Question 7.

Questions from Senator John Barrasso

11. I notice that your testimony includes an emphasis on our “responsibility to mitigate through forest management.”

Could you elaborate on that point, specifically fuels treatment?

Healthy forests and their associated wildlife habitats and watersheds are priceless assets providing the nation with critical values and uses. The sustainable management and conservation of forests is crucial to societal welfare. When forests are allowed to become overly dense the trees lose vigor and become susceptible to insects, disease, mortality, and fire. This is exacerbated under conditions of overall rise in temperature, drought, and storms. It is therefore in society's best interest that, apart from ecological reserves, wilderness or similar areas, forests be sustainably managed to maintain forest health and provide the balance and diversity of values and uses that society needs.

The argument that forests, especially national forests, should be left unmanaged and that "nature knows best" is understandably appealing. However it does not recognize that the condition of our national forests is far from "natural". People are an integral and often dominant part of ecosystems and rapidly increasing human populations have drastically changed forest structure and composition through harvesting, development, infrastructure, and wildfire suppression policies. Forests could be allowed to "develop naturally", but nature's way of reducing stand density is through tree mortality through competition, suppression, insect/disease attacks, and wildfire. Natural forests start as tens to hundreds of thousands of seedlings per acre and at maturity may only have fifty dominants. The natural process of forest succession is therefore characterized by natural agents continually causing tree mortality. However, in today's context, these forest successional processes represent loss of critical forest values, risk to life and property, and are most certainly societally unacceptable. The difficulty is that human timeframes of what is important and acceptable are far shorter than nature's long-term cycles of ecological succession. Actually, our only realistic option is to manage our forests to reduce risks and to sustain the values and uses upon which we are dependent.

The challenge is how to accomplish this in a socially acceptable and economically feasible way. Societal acceptance can probably only be achieved through a combination of Congressional leadership and science-based information outreach. In particular, decision-making processes are needed that emphasize stakeholder common interests in restoring healthy forests to reduce wildfires, mitigating the effects of climate change, and striking a balance among competing values and viewpoints. The overall policy goal should be to restore and sustainably manage the nation's forests for the welfare of society at large. Since fuels treatments and thinning are costly, it is critical to explore ways and means by which these costs can be offset by utilizing the biomass in the form of energy or renewable wood products. The desirability of this option becomes apparent when one appreciates that using wood can reduce carbon emissions where it is used in place of alternative materials that life cycle analyses show have higher energy requirements in manufacture.

I used the word "responsible" in my testimony in the context that failure to restore forest health and reduce impacts of wildfire and insects on wood supply, wildlife habitat, and water supply is to abdicate current society's responsibilities to present and future generations.

Questions from Senator Bob Corker:

12. Do we need to reconsider forest management policies or other mitigation activities? Are there currently obstacles to forest management that could significantly reduce the damage caused by fires that will only continue to compound the problem if temperatures continue to rise?

Forests are a critical national resource. They are owned by state and federal agencies, industries, tribal groups, and non-industrial family owners having diverse goals and objectives. Issues of climate change transcend property boundaries. It is important, therefore, to examine current laws and regulations to determine opportunities for coordinated policies and cooperative management at the landscape level. Flexible policies, regulations, and incentives are needed to readily accommodate mitigation opportunities that are time-sensitive and likely to be ownership-, location- and forest-specific.

The major obstacle to forest management on national forest lands is the strong perception by some that no trees should be cut to provide wood products needed by society. It seems imperative that society understand and support the need to reduce the density of trees on national forests that are so susceptible to mortality, fuel build-up, wildfires, and insect attack. This situation will be exacerbated as temperatures rise, storms increase in frequency, and changed precipitation patterns lead to droughts. Society must recognize that the enormous funding needed to address the problem and to thin the national forests is simply not available and that it is in society's best interests to carry out the needed thinning treatments through the sale of biomass for energy and for wood products that store carbon. It is important that the public and decision makers consider whether it is environmentally, ethically, or strategically appropriate that the US, although having the capacity to be self-sufficient in wood, imports 36 percent of wood consumed and that California, for example, imports 80 percent of its wood needs from other states or countries.

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