Understanding Climate

Change and How It Affects Wildlife

Every hunter-conservationist should care about climate and care even more about what policy makers are contemplating regarding climate change. "Why?" you might ask.

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First, climate affects the livability of a place for all plants, animals, and people. And it is changing, apparently at an unprecedented rate. Second, any time policy makers decide to take action and take sides, there is potential for both good and mischief as interest groups push their agendas. It is not clear yet whether more good than mischief is occurring in the international-, national-, and state-level discourses on climate change. So, let's look at some facts and see if we can figure out what is really going on and what is assumed or inferred to be going on. In contrast to revealing an "inconvenient truth," this article searches for truth.

If you are perplexed about climate and what is causing it to change, you are not alone. The scientific community appears to be grouping into three camps:

- **Believers in human-aided rapid global warming** and the possible future outcomes of scenarios run in global climate computer models (including the United Nations Intergovernmental Panel on Climate Change [IPCC] and the National Academy of Sciences);
- **Naysayers who doubt some or many of IPCC's conclusions** and model results (including some of the 400 international scientists cited on Senator James Inhofe's web site); and
- **Skeptics,** including many scientists, who believe the data clearly show that warming is underway but seek to distill fact from fiction on what is causing it, where we are headed, and what can be done if we do not like where we appear to be going.

I am in the third group. I neither fully believe everything from the first group nor do I doubt everything. Science advances from the very kind of debate and challenge and rethinking that is currently underway on climate change. You will have to make your own choice on where to land. But sitting on the sidelines while others decide on policies that could affect wildlife habitats and populations should not be an option.

So, What Do The Data Tell Us?

Climate is changing at local to global scales. It appears to be changing at a rate faster than for at least the past 650,000 years. Rate of change may be the biggest challenge we face on climate change, and it appears to be the strongest factor implicating human activities, as at least a partial cause for current change. The general trend is warming, but even that is not happening everywhere. The warming trend increases with latitude, at least in the northern hemisphere. That is why we see so much attention to north polar ice caps, polar bears, and the Greenland ice sheet.

The data also show that climate has always been changing and that we are still within an envelope of cyclical change characteristic of the past 2.75 million years, during which time Earth has experienced polar, montane, and continental ice advances and retreats an estimated 40 to 50 times. Modern human civilization evolved entirely within the current interglacial period of the past 12,000 years, plus or minus a few thousand years. Behaviorally modern humans evolved and colonized Eurasia, Southeast Asia, and Australia during several of the most recent glacial-interglacial cycles. Those early people had to cope with climate change without the technologies and infrastructure we currently possess. Some scientists posit that stresses and adaptations created by climate dynamics propelled human evolution.

Whether it is warming or cooling and regardless of who or what is causing it, species must respond to change in their living conditions.

Effects of Rapid Climate Change

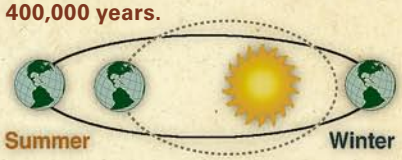
Prior to the advent of agriculture some 10,000 to 12,000 years ago, human populations were organized into small hunter-angler-gatherer bands likely not larger than 50 to 100 people, and their populations were limited by available resources and conflicts over access to those resources. Until agriculture flourished, the total human enterprise was simply not capable of exerting much influence over the global environment. But they certainly affected local environments, sometimes in substantial and permanent ways. There is increasing evidence that local extirpation or extinction of large mammals and flightless birds attended early colonization by and expansion of modern humans. This is true of North America and its Pleistocene megafauna (e.g., mammoths, ground sloths, dire wolves, giant bison, giant beavers, horses) and of South America, Europe, Australia, and oceanic islands. Why it did not happen to the same degree in Asia and Africa is not clear.

Climate Change Factors

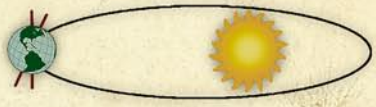
Prior to that time around 10,000 years ago, Earth's climate was entirely the result of a complex interaction of changes in the shape of the planet's orbit around the sun (eccentricity), changes in the tilt of the polar axis (obliquity), changes in how close the northern hemisphere is to the sun at a particular season (precession), changes in solar activity, changes in ocean currents, volcanic activity, and other lesser factors. Ultimately, climate is all about how much solar energy reaches the planet and how much of that energy is trapped within the atmosphere. The latter is where greenhouse gases such as CO_2, methane, and water come into play.

Collectively, the "natural" climate forces create cycles within cycles within cycles of change ranging from as long as 400,000 years to as short as three to five years. The major orbital changes cause the glacial and interglacial periods principally by varying how much energy reaches the northern hemisphere in summer; the smaller changes and events cause

ECCENTRICITY | Shape of the Earth's orbit around the sun. 100,000 and 400,000 years.



OBLIQUITY | Changes in the tilt of the polar axis. 41,000 years.



PRECESSION | How close the northern hemisphere is to the sun at a particular season. 22,000 years.

the variations within the larger cyclical periods (e.g., Medieval Warm, Little Ice Age, Pacific Decadal Oscillation, El Nino). Nothing has changed this. Climate on our planet stills works this way. Whatever the impact of human activity might be on climate, it exists within this large, non-human context of constant cyclical change.

But then came agriculture and the population growth and technological advances it enabled. Agriculture changed the role of humans in their environments from local to eventually global actors. It allowed larger groups of people to live in organized communities, to create stratified societies, to organize warfare, and to expand trade networks. Agriculture requires the conversion of wild ecosystems to managed ecosystems, mostly grasslands and forests to farms. In many places it also requires the impoundment and diversion of water for irrigation. In some places it entails terracing of hillsides or creation of soils less prone to flooding. In a relatively short period of time, humans went from engineering flora, fauna, and ecosystems at local scales to meet their subsistence needs to engineering the same at regional and global scales to meet greatly increased needs and wants.

Dr. William Ruddiman, a prominent environmental scientist now retired from the University of Virginia, says the data show early effects of humans on climate associated with forest conversion to farms nearly 10,000 years ago (*Plows, Plagues & Petroleum*, Princeton Univ. Press, 2005). Forests and grasslands store far more carbon in their vegetation and soils than do the farms that replace them. The conversion process releases most of the CO_2 stored in the forest to the atmosphere, where it traps radiant heat from leaving the earth's surface, the greenhouse effect.

Ruddiman goes on to suggest that human-aided climate effects increased with population growth and further forest conversion, notably with the advent of metallurgy during the bronze and iron ages 5,000-3,500 years ago. Early metal working used lots of wood to fuel the smelters and furnaces. The industrial era of the past 150 years, fueled by burning the hydrocarbons of fossil fuels, has been the most recent augmentation of human impacts. Somewhere along the way, Ruddiman suggests, humans took control of the climate. This is a profound and provocative proposal because it implies that the effect of humans on global climate has been going on for longer than many think and it may be more pronounced than many think.

The significance of Ruddiman's thesis has so far been lost in the political debate over what is causing climate change and what can or should be done about it. The scientists who first confirmed the role of Earth's orbital cycles in climate change back in the mid 1970s suggested that those orbital forces should have the planet headed toward another ice age within a few thousand years. Dr. Ruddiman says it should have started 6,000 to 4,000 years ago. If these assessments of the impacts of orbital forces in changing current or future global climate are correct, something must have happened to forestall or prevent the close of the current interglacial. The only plausible explanation, according to Bill Ruddiman, is human-caused emissions of greenhouse gases.

Why Is This Relevant?

One reason: The effects of climate on where wild things can live are enormous. The impact of climate change on flora and fauna distributions from glacial to interglacial periods has been measured to be as much as 1,000 miles latitude and

3,000 feet in elevation. You might recall mammoth bones in the La Brea tar pits of southern California for just one example.

Whether it is warming or cooling and regardless of who or what is causing it, species must respond to change in their living conditions. Because of the human enterprise, they are now forced to respond in landscapes that are nothing like what they had to adapt to in the past.

Never in Earth's history has there been a single species so dominant in its alteration of the planet as humans. Our population is now 11 times what is was just 1,000 years ago. Our hardened infrastructure of roads, reservoirs, dams, farms, and cities to support those numbers of people make free movement of many animals in response to changing living conditions problematic. Those species that cannot cope will either need assistance from humans or they will disappear. Some of them may be species near and dear to our hearts, some the very reasons conservationists protect wild places when they could just as easily convert them to more immediate utility.

Another reason to care is that if Dr. Ruddiman is right, it may not be in humanity's best interest to reverse all of the impacts of greenhouse gases on climate. Conceivably, the people currently living in Canada and northern Europe might prefer warm to ice.

The Effect on Wildlife

Current and proposed policy responses to climate change are highly varied in their potential consequences for wildlife. Some appear to be good for wildlife, at least those species that favor forests of any type and older forests in particular.

The Kyoto Protocol on climate change, developed in response to the 1992 Earth Summit in Rio de Janeiro, did not address wildlife or the role of forests in climate. The recent Bali Accord on climate, developed to begin the international process of replacing the Kyoto Protocol, would reward countries for reversing deforestation in the tropics, but it still ignores many other potential roles for forests and forest products in mitigating undesired levels of atmospheric CO_2. Current legislation moving through the Senate, S. 2191, favors storing more carbon in forests. It addresses deforestation effects on climate and has some provisions for addressing wildlife concerns but it does not account for what forest and other habitat stewards and users of forest products have already done to store carbon.

Most troubling of all climate policy options to date is the use of biomass to make fuels as an offset to fossil fuels (biomass is the organic matter in plants and animals that has stored carbon as carbohydrates such as sugars and cellulose). Not only would it be highly subsidized—where do the subsidy dollars come from?—but some of it would divert food crops into fuel crops. This would have two significant negative consequences, both of which are already appearing. Increased demand for corn, soybeans, or sugar cane for fuels drives the costs of food commodities up, rippling through all markets, but affecting the poor most directly. And it drives the conversion of wildland into fuel-crop production, to the detriment of wild habitats and wildlife. We could see conservation reserves for wildlife revert to farms for biofuels.

These are just a few among the many reasons why hunter-conservationists must become more engaged in the scientific and policy debates on climate change and appropriate policy responses. We need to ensure that wildlife and their habitats are fully considered in policy options so they do not end up as unintended consequences. We need to help people discern truth from fiction and speculation and to better understand the difference between actual data and model projections based on some data and some simplifying assumptions. I am reminded of the great question that biologist Garrett Hardin posed to any problem solver who thought they just found the solution to a complex problem: and then what? When? Where? ■

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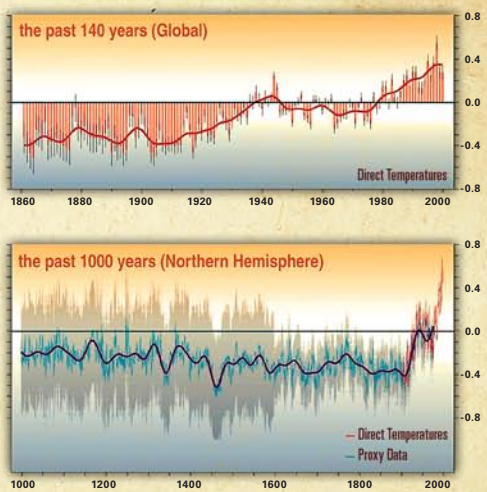
Variations of the Earth's Surface Temperature for...



Graphs show departure in temperature in °C from the 1961-1990 average.

The Kyoto Protocol is an agreement made under the United Nations Framework Convention on Climate Change (UNFCCC). Countries that ratify this protocol commit to reduce their emissions of carbon dioxide and five other greenhouse gases, or engage in emissions trading if they maintain or increase emissions of these gases. The Kyoto Protocol now covers more than 170 countries globally and more than 60% of countries in terms of global greenhouse gas emissions. As of December 2007, the US and Kazakhstan are the only signatory nations not to have ratified the act. This treaty expires in 2012, and international talks took place in Bali this past May on a future treaty to succeed the current one. The new treaty is commonly referred to as the Bali Accord.

The goal of The America's Climate Security Act of 2007 (S. 2191) is to substantially reduce U.S. greenhouse gas emissions (GHGs) over the 2012-2050 period. The Act covers electric power, transportation, and manufacturing sources, which account for 75 percent of U.S. emissions. The cap requires reducing emissions to 2005 levels by 2012 and then lowers emissions at a constant rate, reaching 1990 levels by 2020 and then a target of 65 percent below 1990 levels by 2050. The Act also strengthens energy efficiency standards for appliances and buildings in order to address commercial and residential sector emissions not covered by the emission reduction targets.