**REVIEW OF *Climate Change Impacts in the United States: The Third National Climate Assessment.* U.S. Global Change Research Program**
Jerry M. Melillo, Terese (T.C.) Richmond, and Gary W. Yohe, Eds.
841 pp. doi:10.7930/J0Z31WJ2.

**By Daniel B. Botkin: May 29, 2014**

[Note regarding my connections with Jerry M. Melillo, one of the three primary editors of this report: When I was on the faculty of the Yale School of Forestry and Environmental Studies, Jerry Melillo was a graduate student working on his doctorate and we interacted frequently. Beginning in 1975, Jerry Melillo and I worked at the Ecosystems Center, Marine Biological Laboratory, Woods Hole, MA, and we published four scientific papers together, listed at the end of this document.[1]

## COMMENTS ON THE ASSESSMENT

### GENERAL COMMENTS:

**The opening statement of the Assessment (p.1), reproduced here, is characteristic of the entire Assessment in that it violates one of the basic principles of good climatology --- never use short-term weather changes as proof of climate change. Climatologists I have worked with over the decades have said this repeatedly. In 1962, when I was a graduate student at the University of Wisconsin working under a science writing fellowship, I spoke with Reed Bryson, said to be the father of the International Geophysical Year and the person who persuaded Richard Keeling to begin measuring atmospheric carbon dioxide concentration on Mauna Loa, Hawaii. At that time Earth had been undergoing a global cooling since about 1940. At first Professor Bryson said "if present trends continue, we are entering a new ice age." But when I drafted a press release that quoted him so, he thought about it carefully and told me that we could not make that statement, because this was just a short-term weather event.**

**In the 1980s, I worked closely with climatologist Stephen Schneider and we often gave talks at the same events. Steve, one of the leaders of the modern concern about a possible human-induced global warming, also said that you should never use short-term weather events to infer climate change. I agreed with these experts, and therefore was taken aback by the overall tone of the new White House Climate Change Assessment, which begins: "**Climate change, once considered an issue for a distant future, has moved firmly into the present. Corn producers in Iowa, oyster growers in Washington State, and maple syrup producers in Vermont are all observing climate-related changes that are outside of recent experience. So, too, are coastal planners in Florida, water managers in the arid Southwest, city dwellers from Phoenix to New York, and Native Peoples on tribal lands from Louisiana to Alaska. This National Climate Assessment concludes that the evidence of human-induced climate change continues to strengthen and that impacts are increasing across the country.

Based on what my climatologist colleagues had always told me, the Assessment should

have begun instead by stating: *"Corn producers in Iowa, oyster growers in Washington State, and maple syrup producers in Vermont are all observing weather-related changes" outside of their personal recent experience. So, too, are coastal planners in Florida, water managers in the arid Southwest, city dwellers from Phoenix to New York, and Native peoples on tribal lands from Louisiana to Alaska."*

The Assessment concludes that opening paragraph by stating: *This National Climate Assessment concludes that the evidence of human-induced climate change continues to strengthen and that impacts are increasing across the country.*

*Americans are noticing changes all around them. Summers are longer and hotter, and extended periods of unusual heat last longer than any living American has ever experienced. Winters are generally shorter and warmer. Rain comes in heavier downpours. People are seeing changes in the length and severity of seasonal allergies, the plant varieties that thrive in their gardens, and the kinds of birds they see in any particular month in their neighborhoods* (p.1).

**These opening paragraphs and several that follow directly communicate to the reader, both lay and professional, that human-induced global warming in an immediate disaster. For example:**

*Other changes are even more dramatic. Residents of some coastal cities see their streets flood more regularly during storms and high tides. Inland cities near large rivers also experience more flooding, especially in the Midwest and Northeast. Insurance rates are rising in some vulnerable locations, and insurance is no longer available in others. Hotter and drier weather and earlier snowmelt mean that wildfires in the West start earlier in the spring, last later into the fall, and burn more acreage. In Arctic Alaska, the summer sea ice that once protected the coasts has receded, and autumn storms now cause more erosion, threatening many communities with relocation.*

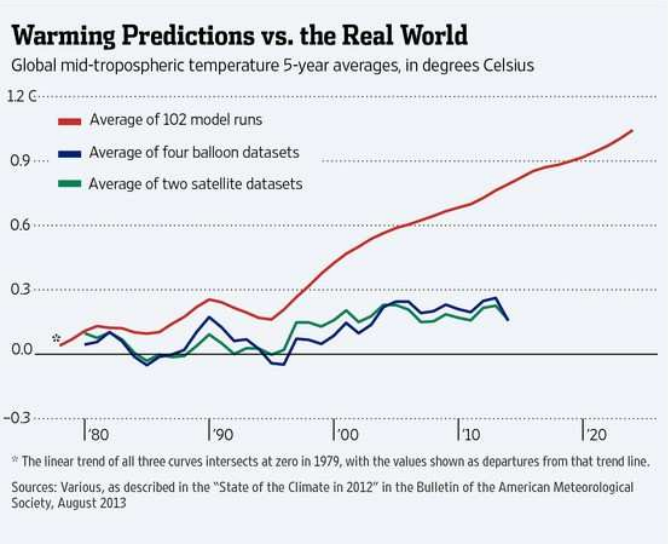
*Scientists who study climate change confirm that these observations are consistent with significant changes in Earth's climatic trends. Long-term, independent records from weather stations, satellites, ocean buoys, tide gauges, and many other data sources all confirm that our nation, like the rest of the world, is warming. Precipitation patterns are changing, sea level is rising, the oceans are becoming more acidic, and the frequency and intensity of some extreme weather events are increasing* (p. 1).

To be scientifically accurate, these paragraphs should instead have been written (my changes noted by underlining): *Other <u>weather</u> changes are even more dramatic. Residents of some coastal cities see their streets flood more regularly during storms and high tides. Inland cities near large rivers also experience more flooding, especially in the Midwest and Northeast. Insurance rates are rising in some vulnerable locations, and insurance is no longer available in others. Hotter and drier <u>weather</u> and earlier snowmelt mean that wildfires in the West start earlier in the spring, last later into the fall, and burn more acreage. In Arctic Alaska, the summer sea ice that once protected the coasts has receded, and autumn storms now cause more erosion, threatening many communities with relocation.*

*Scientists who study <u>weather and</u> climate change <u>point out that short-term, including several decades and longer, changes in weather do not</u> confirm that these observations are consistent with significant changes in Earth's climatic trends.*

These opening statements are directly followed by: *Many lines of independent evidence demonstrate that the rapid warming of the past half-century is due primarily to human activities. The observed warming and other climatic changes are triggering wide-ranging impacts in every region of our country and throughout our economy. Some of these changes can be beneficial over the short run, such as a longer growing season in some regions and a longer shipping season on the Great Lakes. But many more are detrimental, largely because our society and its infrastructure were designed for the climate that we have had, not the rapidly changing climate we now have and can expect in the future. In addition, climate change does not occur in isolation. Rather, it is superimposed on other stresses, which combine to create new challenges* (p. 1). **The assertions in this paragraph are based on the forecasts from climate models and from temperature records. However, Figure 1 shows that the climate models greatly exaggerate the rate and amount of temperature change and are not making forecasts that come even close to fitting the data. Furthermore, Figure 1 also shows that the average Earth temperature in the past 30 years has changed very little if at all, contradicting the assertions on the first page of the Assessment.**

**Figure 1: Climate model forecasts compared to real world temperature observations** (From John Christy, University of Alabama and Alabama State Climatologist. Reproduced with permission from him.)



**The Assessment further attributes the supposed climatic warming to human activities that are releasing greenhouse gases, especially carbon dioxide, into the atmosphere. Therefore the claimed disaster is our fault. But recent evidence shows that temperature change is not tracking the increase in carbon dioxide. The gas has increased from 370 ppm to just over 400ppm, 8 percent, between year 2000 and year 2014 (Figure 2), while the temperature has changed either only slightly or not at all, depending on how one does the analysis (Figure 3). Instead, temperature change tracks closely changes in the energy output from the sun (Figure 4).**

**Figure 2. Mauna Loa Observatory $CO_2$ measurements**

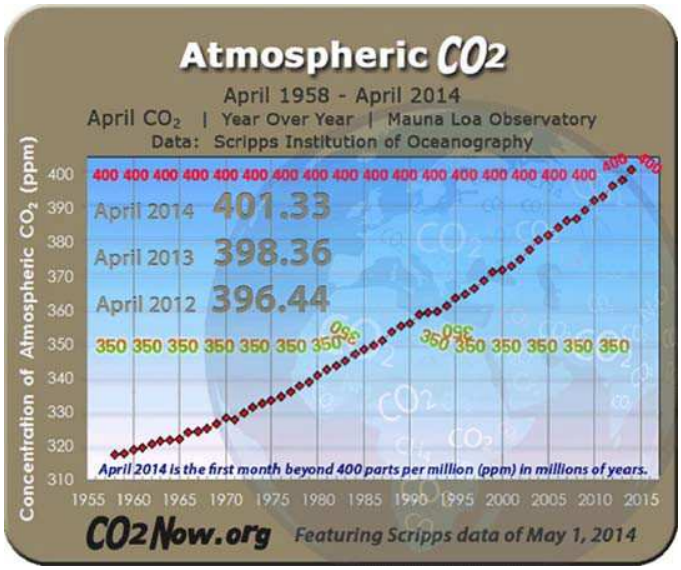



**Figure 3. Earth Surface Temperature Departure from 1950-1980 Average**

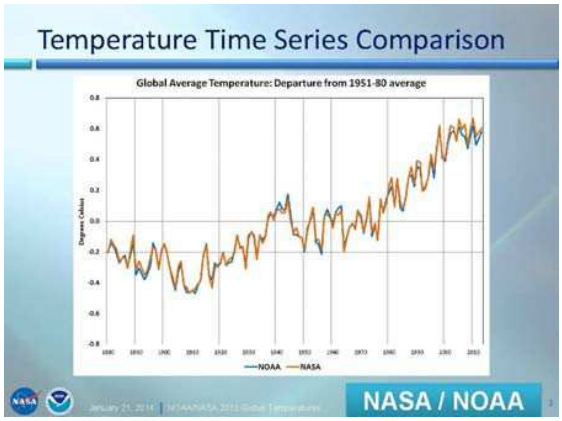
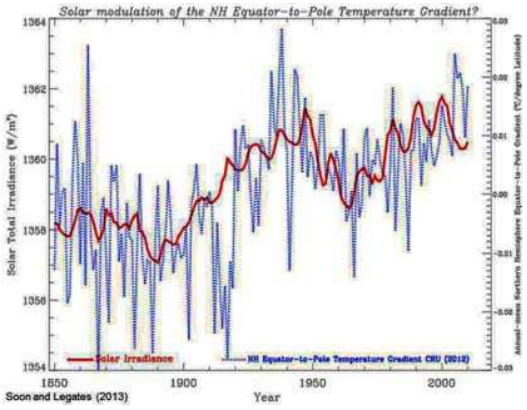


**Figure 4. Correlation Between Solar Irradiance and Poleward flux of energy. Thus the Assessment's early statements about the dangerous climate change have to do with a hypothetical, not a real, world.**




**The current evidence from scientific observations show that Earth's temperature has not changed very much, if at all, since the start of the new century, while carbon dioxide has increased considerably.**

**Given these facts, the basic opening assertions of the new U.S. Climate Change Assessment are about a hypothetical world, not a real world, and must be taken as a "what if" rather than "what is". Therefore the dire consequences forecast in the Assessment cannot be taken as reliable, nullifying many, if not most, of the ecological and biological implications the Assessment makes heavy use of.**

The time available to write and the space available to publish as written testimony prevent a comprehensive, detailed review of the entire White House Climate Change Assessment. As a result, I have used as an example of the kinds of problems throughout the Assessment the table appearing on pages 204-5, *Biological Responses To climate Change.* As an ecologist, I have taken that table and reorganized it. This reorganization follows.

Although the document is titled "Climate Change Assessment," the term "climate change" is not defined and is in fact used with two meanings, natural and human-induced. There are places in the Assessment where only the second meaning makes sense, so that meaning has to be assumed. There are other places where either meaning could be applied. In those places where either meaning can be interpreted, if the statement is assumed to be a natural change, then it is a truism, a basic characteristic of Earth's environment and something people have always known and experienced. If the meaning is taken to be human-caused, then in spite of the assertions in the Assessment, the available data do not support the statements.

For example, the Assessment's section titled *CLIMATE CHANGE AND THE AMERICAN PEOPLE* begins with the statement: *Climate change, once considered an issue for a distant future, has moved firmly into the present. Corn producers in Iowa, oyster growers in Washington State, and maple syrup producers in Vermont are all observing climate-related changes that are outside of recent experience.*

If this is to be interpreted as natural, then people have frequently in history experienced

"climate-related changes that are outside of [their] recent experiences," as the Medieval Warming and Little Ice Age demonstrate,[2, 3, 4] and therefore it is not unusual nor unexpected in ordinary life. If this is to be interpreted to be human-induced, then the evidence just discussed demonstrates that this kind of change cannot be attributed to human actions and therefore the statement is false.

## ANALYSIS OF THE CLIMATE CHANGE IMPACTS ASSESSMENT TABLE OF ECOLOGICAL EFFECTS (Assessment's pages 204-205)

**Biological responses to climate change**

The Assessment presents a list of 30 biological responses to climate change. Since this is my particular area of expertise, I have analyzed this list and sorted the items into the following categories: **Where the Assessment is wrong** based on my understanding (10 items); **Improvements** (12 items); **Declines** (which can be taken as worsening) (No items); **Predicted from Climate Models,** Therefore Not Fact, especially given the failure of climate models to forecast with any reliability Earth's increase in temperature since the 1990s (see figure 1) (3 items); and **Unlikely or Unsupported** Statement (5 items). **Within the context of the Assessment, this table comes across as meaning to demonstrate more very negative effects of a human-induced global warming, but since upon analysis none of the 30 appears to be a legitimately supported decline that might occur under a hypothetical global warming or have been directly observed, this table in fact is an argument against the overall message of the Assessment.**

(The number that appears at the beginning of each entry is the number in the Assessment's list. The numbers following each of the Assessment's entry are the citation number as listed in the Assessment. The Assessment's statements are in italics; my comments appear in plain font.)

**ASSESSMENT IS WRONG**

1. *21. Seedling survival of nearly 20 resident and migrant tree species decreased during years of lower rainfall in the Southern Appalachians and the Piedmont areas, indicating that reductions in native species and limited replacement by invading species were likely under climate change.134* Since the climate models are admittedly weak about changes in rainfall, this statement has no relevance to purported human-induced global warming.
2. *27. Water temperature data and observations of migration behaviors over a 34-year time period showed that adult pink salmon migrated earlier into Alaskan creeks, and fry advanced the timing of migration out to sea. Shifts in migration timing may increase the potential for a mismatch in optimal environmental conditions for early life stages, and continued warming trends will likely increase pre-spawning mortality and egg mortality rates.**87*** Salmon have evolved and are adapted to environmental change.
3. *3. Conifers in many western forests have experienced mortality rates of up to 87% from warming-induced changes in the prevalence of pests and pathogens and stress from drought.118* Important causes of the mortality of trees in western forests are: fire suppression, which promotes insect and disease outbreaks, and from introduced (invasive) insects and diseases. The paper cited is much more careful in the analysis than the Assessment statement, That paper states: "Regional warming and consequent increases in water deficits are likely contributors to the increases in tree mortality

rates," and "Instead, the evidence is consistent with contributions from exogenous causes, with regional warming and consequent drought stress being the most likely drivers."

4. *8. Warmer and drier conditions during the early growing season in high-elevationhabitats in Colorado are disrupting the timing of various flowering patterns, with potential impacts on many important plant-pollinator relationships.77 On the contrary, the authors conclude that such timing changes are"that phonological decoupling alone is "unlikely to threaten population persistence for most species in our study area." Also, "Disrupting" is a politically loaded term. The scientific term would be "changed" "*
5. *12. Variation in the timing and magnitude of precipitation due to climate change was found to decrease the nutritional quality of grasses, and consequently reduce weight gain of bison in the Konza Prairie in Kansas and the Tallgrass Prairie Preserve in Oklahoma.124.* Results provide insight into how climate change will affect grazer population dynamics in the future. This is stated in a way that is not open to scientific evaluation. No doubt lower rainfall has negative effects, but the statement is "variation." In fact, the publication cited (Craine et al., 2008)[5] states that "Greater late-summer precipitation increased bison weight gain . . . "greater midsummer precipitation decreased weight gain." This is a scientifically interesting result for those focused on wildlife in grasslands, but it is neither a negative nor positive in terms of global warming, because the forecasting models are weakest in forecasting rainfall even annually, let alone seasonally. Therefore these results cannot be taken as negative (nor positive) effects of a global rise in average temperature.
6. *10. Cutthroat trout populations in the western U.S. are projected to decline by up to 58%, and total trout habitat in the same region is projected to decline by 47%, due to increasing temperatures, seasonal shifts in precipitation, and negative interactions with nonnative species.8.* The paper cited uses "outputs from general circulation models," which are acknowledged even by their creators to be weakest in forecasting precipitation, so these "projections" have to be taken as what might happen if a hypothetical and theoretically unvalidated and doubtful decline in water flow occurred, rather than a reliable forecast. It is a "what if" not a "what is likely to be". Stresses on Cutthroat extend considerably beyond climate change and have to do with fishing intensity, water diversions and other habitat changes, such as competition from introduced, invasive species such as lake trout and rainbow trout.[6]
7. 28. *Warmer springs in Alaska have caused earlier onset of plant emergence, and decreased spatial variation in growth and availability of forage to breeding caribou. This ultimately reduced calving success in caribou populations.*138 The implication is that warming will necessarily have a negative effect on caribou, but the paper cited (Post et al., 2008) actually is much more cautious, stating "*it is highly relevant to herbivore ecology to consider the manner in which warming will alter spatial patterns of plant phenology at more immediate spatial scales than that of the regional landscape.* The paper concludes, cautiously: " *Large herbivores prefer newly emergent forage, presumably owing to the high digestibility and nutrient content of young plant tissues . . . future warming could conceivably impair the ability of herbivores such as caribou to forage selectively, with adverse consequences for their productivity.We suggest,*

*therefore, that it is highly relevant to herbivore ecology to consider the manner in which warming will alter spatial patterns of plant phenology at more immediate spatial scales than that of the regional landscape*."[7]

There is again an inherent assumption that a steady-state between living things and climate is natural and necessary for a species's persistent. Wildlife population can and do adjust to changes, but this can take some time. See the examples of current adjustments, which I have added below this table. Give the populations a little time to adjust.

8. *26. Changes in female polar bear reproductive success (decreased litter mass and numbers of yearlings) along the north Alaska coast have been linked to changes in bodysize and/or body condition following years with lower availability of optimal sea ice habitat.137.* There is evidence that polar bears are adjusting by feeding more on terrestrial prey. Contrary to the publicity about polar bears, there is little information demonstrating any statistically, scientifically valid decline in polar bear populations. I have sought the available counts of the 19 subpopulations. Of these, only three have been counted twice; the rest have been counted once. Thus no rate of change in the population is possible. The first count was done 1986 for one subpopulation.[8]

9. *7. Quaking aspen-dominated systems are experiencing declines in the western U.S. after stress due to climate induced drought conditions during the last decade.122 Anderegg,*
*W. R. L., J. M. Kane, and L. D. L. Anderegg, 2012: Consequences of widespread tree mortality triggered by drought and temperature stress. Nature Climate Change, 3, 30-36, doi:10.1038/nclimate1635.* Given the failure of the climate models to predict temperature change and the observed lack of a significant recent rise in temperature, it is incorrect to refer to this as a "climate induced' drought. Moreover, a thousand year tree-ring study shows that deep droughts are characteristic of California. Meteorologist Martin P. Hoerling wrote on March 8,2014 that "At present, the scientific evidence does not support an argument that the drought there is appreciably linked to human-induced climate change." Hoerling is a research meteorologist, specializing in climate dynamics, at the Earth System Research Laboratory of the National Oceanic and Atmospheric Administration, and the White House's National Climate Assessment cites many of Hoerling's papers, including figure 20.4 "Longer Frost-free Season Increases Stress on Crops," so his work is respected by the authors.

1. 10. 9. *Population fragmentation of wolverines in the northern Cascades and Rocky Mountains is expected to increase as spring snow cover retreats over the coming century.*123
2. Population fragmentation of wolverines in the northern Cascades and Rocky Mountains is expected to increase as spring snow cover retreats over the coming century. The idea is that less snow cover means smaller and more fragmented areas where the wolverine lives in winter. But the paper cited as the source for this (citation 123, page 214) states to the contrary that: "Large (greater than 1000 sq. km.) contiguous areas of wolverine habitat are predicted to persist within the study area throughout the 21st century for all projections." And the analysis is based on forecasts of snow cover from climate models, which are acknowledged even by their authors to be weakest in forecasting precipitation.

**IMPROVEMENTS**

1. *2. Northern flickers arrived at breeding sites earlier in the Northwest in response to temperature changes along migration routes, and egg laying advanced by 1.15 days for every degree increase in temperature, demonstrating that this species has the capacity to adjust their phenology in response to climate change.117*
2. *11. Comparisons of historical and recent first flowering dates for 178 plant species from North Dakota showed significant shifts occurred in over 40% of species examined, with the greatest changes observed during the two warmest years of the study.75*
3. *14. Migratory birds monitored in Minnesota over a 40-year period showed significantly earlier arrival dates, particularly in short-distance migrants, indicating that some species are capable of responding to increasing winter temperatures better thanothers.126.*
4. *15. Up to 50% turnover in amphibian species is projected in the eastern U.S. by 2100, including the northern leopard frog, which is projected to experience poleward and elevational range shifts in response to climatic changes in the latter quarter of the century.127*
5. *16. Studies of black ratsnake (Elaphe obsoleta) populations at different latitudes in Canada, Illinois, and Texas suggest that snake populations, particularly in the northern part of their range, could benefit from rising temperatures if there are no negative impacts on their habitat and prey.128*
6. *17. Warming-induced hybridization was detected between southern and northern flying squirrels in the Great Lakes region of Ontario, Canada, and in Pennsylvania after a series of warm winters created more overlap in their habitat range, potentially acting to increase population persistence under climate change.129*
7. *18. Some warm-water fishes have moved northwards, and some tropical and subtropical fishes in the northern Gulf of Mexico have increased in temperate ocean habitat.130 Similar shifts and invasions have been documented in Long Island Sound and Narragansett Bay in the Atlantic.131*
8. *23. Over the last 130 years (1880-2010), native bees have advanced their spring arrival in the northeastern U.S. by an average of 10 days, primarily due to increased warming. Plants have also showed a trend of earlier blooming, thus helping preserve the synchrony in timing between plants and pollinators.135*
9. *24. In the Northwest Atlantic, 24 out of 36 commercially exploited fish stocks showed significant range (latitudinal and depth) shifts between 1968 and 2007 in response to increased sea surface and bottom temperatures.55*
10. *25. Increases in maximum, and decreases in the annual variability of, sea surface temperatures in the North Atlantic Ocean have promoted growth of small phytoplankton and led to a reorganization in the species composition of primary (phytoplankton) and secondary (zooplankton) producers.136*
11. *29. Many Hawaiian mountain vegetation types were found to vary in their sensitivity to changes in moisture availability; consequently, climate change will likely influence elevation-related vegetation patterns in this region.139*
12. *5. In response to climate-related habitat change, many small mammal species have*

*altered their elevation ranges, with lower-elevation species expanding their ranges and higher-elevation species contracting their ranges.120*

**DECLINES**
None.

**PREDICTED FROM CLIMATE MODELS, THEREFORE NOT FACT**

1. 30. Sea level is predicted to rise by 1.6 to 3.3 feet in Hawaiian waters by 2100, consistent with global projections of 1 to 4 feet of sea level rise (see Ch. 2: Our Changing Climate, Key Message 10). This is projected to increase wave heights, the duration of turbidity, and the amount of re-suspended sediment in the water; consequently, this will create potentially stressful conditions for coral reef communities.140
2. 6. Northern spotted owl populations in Arizona and New Mexico are projected to decline during the next century and are at high risk for extinction due to hotter, drier conditions, while the southern California population is not projected to be sensitive to future climatic changes.121
3. 19. Global marine mammal diversity is projected to decline at lower latitudes and increase at higher latitudes due to changes in temperatures and sea ice, with complete loss of optimal habitat for as many as 11 species by midcentury; seal populations living in tropical and temperate waters are particularly at risk to future declines.132

**UNLIKELY CORRELATION OR UNSUPPORTED STATEMENT**

1. 13. (a and b) Climatic fluctuations were found to influence mate selection and increase the probability of infidelity in birds that are normally socially monogamous, increasing the gene exchange and the likelihood of offspring survival. 125
2. 20. Higher nighttime temperatures and cumulative seasonal rainfalls were correlated with changes in the arrival times of amphibians to wetland breeding sites in South Carolina over a 30-year time period (1978-2008).133 Of course. The time period precedes any possible effect of human-induced global warming, and the effect is a truism. Rainfall will affect amphibians. Since the climate models are admittedly weak about changes in rainfall, this statement has no relevance to purported human-induced global warming.
3. *22. Widespread declines in body size of resident and migrant birds at a bird-banding station in western Pennsylvania were documented over a 40-year period; body sizes of breeding adults were negatively correlated with mean regional temperatures from the preceding year.*85 The authors do not mention body size change at all, and just make a general statement that there is state to the contrary "There was much variation among species in phenological change, especially in autumn. . . these results illustrate "a complex and dynamic annual cycle in songbirds, with responses to climate change differing among species and migration seasons.".
4. *4. Butterflies that have adapted to specific oak species have not been able to colonize new tree species when climate change-induced tree migration changes local forest types, potentially hindering adaptation.119* The paper cited starts with the assertion that tree species *"*are limited in in their ability to shift theier geographic ranges quickly

under climate change." This is an out-of-date assumption. A variety of recent papers show that tree species have in the past moved more quickly that previously were assumed. Moreover, the paper discusses the ability of butterfly species to use other tree species if such tree migration did not occur and the butterflies could not adjust range range, both hypotheticals of doubtful likelihood. The paper concludes to the contrary of the Assessment's generalization that some species "performed quite well" while others did not, and under the severe assumptions of the analysis "may preclude popualtions from colonizing new locales under climate change." This is again another "what might be" given severe and ecologically unrealistic assumptions.

5. *1. Mussel and barnacle beds have declined or disappeared along parts of the Northwest coast due to higher temperatures and drier conditions that have compressed habitable intertidal space.116*. The implication is that these declines have already happened and apparently over large areas. On the contrary, the paper cited deals with experiments, not with the implied large area actual decline in mussel and barnacle beds. The paper states in reference to the world beyond the experiments that "anthropogenic climate change can alter interspecific interactions and produce unexpected changes in species distributions, community structure, and diversity."

**SOME OTHER EXAMPLES OF SPECIFIC STATEMENTS THAT ARE INCORRECT, OR OVERSTATED, OR LIMITED TO A FEW SPECIFIC CASES, OR OTHERWISE OF DOUBTFUL GENERALITY**

**Given the length of the just-released White House Climate Change Assessment and the time available to review it, I am able to consider only a few examples of other specific problems with the Assessment. I have focused on those that have to do with biological factors. These, however, are representative of problems throughout the Assessment.** (Once again, the material in italics is quotes from the Assessment; the material in standard font is my text.)

*Cores from corals, ocean sediments, ice records, and other indirect temperature measurements indicate the recent rapid increase of ocean temperature is the greatest that has occurred in at least the past millennium and can only be reproduced by climate models with the inclusion of human-caused sources of heat-trapping gas emissions* (p. 559). As we saw earlier, the climate models are not coming even close to forecasting air temperature change, and therefore could not be expected to forecast accurately changes in ocean temperature, so it is not correct to say that something "can only be reproduced by climate models with the inclusion of human-caused sources of heat-trapping gas emissions."

*Warmer air and ocean temperatures are also causing the continued, dramatic decline in Arctic sea ice during the summer (panel D)* (p. 560). We published a paper comparing Arctic sea ice extent in the nineteenth century, using historical records from ships hunting the bowhead whale, with those in recent times.[10] In this paper we wrote, "Records from May indicate that end-of-winter sea-ice extent in the Bering Sea during the mid-19th century closely resembled that in the 1972–82 data. However, the historical data reveal that sea ice was more extensive during summer, with the greatest difference occurring in July. This pattern indicates a later and

more rapid seasonal retreat." While the statement in the White House Climate Change Assessment is not contradicted by our paper, the limited statement (about the summer) in the Assessment once again paints a dire picture to the average reader, whereas our work suggests that in fact the sea ice extent recovered over winter, and changes in arctic sea ice are more complicated than the Assessment implies. The problem here is a matter of tone and communication.

*Key Message 4: Seasonal Patterns: Timing of critical biological events—such as spring bud burst, emergence from overwintering, and the start of migrations—has shifted, leading to important impacts on species and habitats* (p.201). The implication here is that this is entirely negative for life on Earth and will forever be so. But on the contrary, the environment has always changed and is always changing, and living things have had to adapt to these changes. Interestingly, many, if not most, species that I have worked on or otherwise know about require environmental change, including salmon and sequoia trees. [11] [12]

Two of the longest studies of animals and plants in Great Britain show that at least some species are adjusting to recent weather changes in "timing of critical biological events, such as spring bud burst, emergence from overwintering." For example, a 47-year study of the bird *Parus major* (one of the longest monitoring of any bird species) shows that these birds are responding behaviorally to recent weather changes. A species of caterpillar that is one of the main foods of this bird during egg-laying has been emerging earlier as spring temperatures have risen. In response, females of this bird species are laying their eggs an average of two weeks earlier.[13]

The second study, one of the longest experiments about how vegetation responds to temperature and rainfall, shows that long-lived small grasses and sedges are highly resistant to climate change. The authors of the study report that changes in temperature and rainfall during the past 13 years "have had little effect on vegetation structure and physiognomy."[14]

Of course with any environmental change, not all species will do well. This has always been the case, and is consistent with Darwinian evolution and with ecological knowledge. Black guillemots (Cepphus grylle), birds that nest on Cooper Island, Alaska, illustrate that some species are having difficulties adjusting to climate change. (However, black guillemots in their entire range are not a threatened or endangered species. It is only their abundance on Cooper Island that has declined.)

The problem has been that temperature increases in the 1990s caused the sea ice to recede farther from the island each spring. The parent birds feed on Arctic cod found under the sea ice and must then return to the nest to feed their chicks, who are not yet mature enough to survive on their own. For the parents to do this, the distance from feeding grounds to nest must be less than about 30 km, but in recent years the ice in the spring has been receding as much as 500–800 km (300–500 mi) from the island. As a result, the black guillemots on the island have lost an important source of food. The birds have sometimes targeted sculpin, which is not as abundant as cod.[15]

But the real problem these Cooper Island birds face today is egg predation by polar bears. With less sea ice during this time period, bears have gone ashore and eaten young birds. In 2009, of the 180 guillemots that hatched, only one on the island fledged (flew away).The solution to this has been to build bear-proof nesting boxes for the birds. In 2010, bear-proof nesting boxes resulted in about 100 birds that fledged.

Two points emerge here. One is that living things do in fact often adjust to changes in the timing of climate events; if not, there would be little or no life on Earth. The second is that the real problem black guillemots face is here-and-now predation, which can be and has been dealt with and does not require a single focus on whether on not the climate change was human-induced.

**Chapter 7, *Forests*, opens with this:**
*Key Messages*
*1. Climate change is increasing the vulnerability of many forests to ecosystem changes and tree mortality through fire, insect infestations, drought, and disease outbreaks.*
As I noted before, the Assessment suffers from the use of the term "climate change" with two meanings: natural and human-induced. The implication in this key message is that the forest problems are the result of human-induced climate change, but as I have made clear, both the failure of the models and the failure of temperature change to closely track $CO_2$ make this key statement false. Furthermore, it is well known that (1) forest wildfires are largely due to long-term suppression of fires in the twentieth century, which allowed the buildup of excessive fuel; and (2) that insect infestations and disease outbreaks are heavily the result of introduced species and the failure to remove dead and decaying timber from forests. In addition, this key statement is another example where recent weather patterns are said to represent and prove human-induced global warming, which I pointed out at the beginning is incorrect.

**Key Message 2**. *U.S. forests and associated wood products currently absorb and store the equivalent of about 16% of all carbon dioxide ($CO_2$) emitted by fossil fuel burning in the U.S. each year. Climate change, combined with current societal trends in land use and forest management, is projected to reduce this rate of forest $CO_2$ uptake.*

As explained in my review of the IPCC 2014 report, the estimates of carbon uptake by vegetation used by IPCC and in major articles cited by the reports are based on what can best be called "grab samples," a relatively small number of studies done at a variety of times using a variety of methods, mainly in old-growth areas. The results reported by IPCC overestimate carbon storage and uptake by as much as 300%.[16] Therefore this is an unreliable statement.

As I stated at above, these are representative examples of problems that exist throughout the Climate Change Assessment.

**NOTES**

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