June 10, 2014

The Honorable Peter Goldmark, Commissioner of Public Lands
Aaron Everett, Deputy Supervisor
Brad Ack, Policy Director
Washington State Dept. of Natural Resources
P.O. Box 47001
Olympia, WA 98504-7001

Dear Commissioner Goldmark, Mr. Everett, and Mr. Ack:

We are scientists who have researched and written extensively on the science of forest carbon accounting. We write in response to a speech that Commissioner Goldmark made before the Washington Forest Protection Association on November 6, 2013. In this speech, which could have important potential policy implications, Commissioner Goldmark made the point that short-rotation forest management provides the most efficient and effective long-term carbon sequestration benefit.

While we applaud Commissioner Goldmark for recognizing the seriousness and magnitude of anthropogenic climate change, we write to direct his attention to forest carbon accounting papers reflecting that long-term rotations and/or selective harvest forestry provides a better carbon dioxide sequestration benefit on actively managed lands. In addition, we point out research reflecting that un-managed old forests, not young forests, provide the largest carbon stores in the Pacific Northwest.

Below we detail our response to some of the issues that were raised in the speech.

Commissioner Goldmark’s speech made the carbon case in support of short-rotation forestry. However, the Commissioner’s argument fails to acknowledge the more enduring carbon benefits of older forests and does not acknowledge the peer-reviewed science reflecting that older forests sequester, that is store, more carbon than younger rotation, even-aged forestry practices.

In a 1990 paper published in Science, we found that the conversion of old-growth forests to young plantations invariably reduces carbon storage, even when structural components in buildings are considered. Such conversion adds carbon to the atmosphere and this has been demonstrated repeatedly. Relatedly, recent papers reflect that “harvesting with greater frequency and intensity lowers [carbon] storage and does not reduce greenhouse gas emissions.”

1 The speech is available at the TV Washington website: http://www.tvw.org/index.php?option=com_tvplayer&eventID=2013110043A (see minute 52:23).


While some studies suggest that “young forests have higher net primary productivity than old-growth forests,” the total amount of carbon netted from longer-rotation cycles eclipses the amount accrued from 50-year rotations. For example, a study conducted in 2010 found that 50-year Douglas fir rotations store the least carbon, while rotations of 70 years are over twice as effective at storing carbon. In this study, 70- and 90-year rotations yielded an average of 161 carbon tons-per-acre, whereas 50-year rotations yielded only 130 tons-per-acre. Thus, the well-managed 35-50 year-old forests that Commissioner Goldmark referenced are relatively and significantly inferior in sequestering carbon stores compared to 70- or 90-year rotations.

The argument that shorter-rotation forestry sequesters carbon relatively more effectively and efficiently also fails to account for the vast amount of carbon dioxide that is released from the ground when the trees are harvested and the soil is disturbed. As they grow, forests accumulate carbon in their soil and even “over-mature” forests can continue to sequester carbon in the soil. Studies indicate that much of the carbon stored in forests is stored underground; in fact, as much as 59% of carbon stored in U.S. forests is located in soil. However, as part of the logging process, removing vegetation accelerates the decomposition process, causing the rate of carbon oxidation to increase. This releases carbon in greater quantity into the atmosphere.

A 2009 study also questions the thesis that short-rotation clear-cut forestry sequesters carbon better than longer-rotation, partial harvest forestry. In this study, we found that “partial harvest of live trees may lead to higher carbon stores than complete harvest, especially when the interval between harvests is short.”

The carbon accounting issue, then, does not turn on whether forests are managed or unmanaged (as the Commissioner put it), but rather how they are managed. Should these forests be left alone? Should they be managed on a longer rotation schedule? Should they be harvested via

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even-aged (clear-cut) forestry or un-even aged multiple species methods? It is not sound to conflate the issue of relative carbon sequestration effectiveness and efficiency with management or non-management of forests. This characterization, by definition, advocates for management as an end in-and-of-itself when, on the contrary, the carbon issue should turn on the timing and method of forest management. Thus, while forests provide a multitude of societal benefits (carbon and otherwise), we must respectfully disagree with any assertion or implication that short-term (i.e., 35-50 year) management is the most effective or efficient way to store carbon in forests.

It is possible that Commissioner Goldmark’s endorsement of 35-50 year forest rotations was trying to make what is called a “product substitution” argument: that is, using wood products harvested from 35 year-old forests is carbon-preferable to using other structural building materials, such as steel and concrete. This may be true in a narrow sense but it does not follow that young rotation forestry is carbon-superior to long-rotation forestry.

There are several places carbon related to forests can be stored: in the forest ecosystem itself, in the products that derive from harvest of the forest either in use or after they are disposed (such as in a landfill), and potential wood product substitution benefits for replacement of fossil fuel-derived products. These substitutions can in theory result in fossil carbon not being released.

We believe that the benefits of product substitution have been grossly overestimated. While we recognize that substituting wood for other materials can “displace” use of fossil carbon, the first question to ask is how long this displacement occurs. In the CORRIM type analysis the assumption is that displacement lasts forever. There are several problems with this assumption. The first is that it implies that there is an infinite supply of fossil carbon. If the substitution is carried out long enough, then the substitution could exceed the amount of fossil carbon. This raises the question of where the additional fossil carbon would come from: it violates the conservation of mass law because fossil carbon would have to appear out of nowhere to maintain mass balance. A more sensible substitution framework would acknowledge that the displacement occurs until the building is replaced. At that point the substitution can be renewed and maintained by building another wooden building or lost by building with a more energy intensive material. The second problem is that it assumes that if product substitution occurs, the fossil carbon is never used. However, this ignores the effects of market forces that will encourage someone else to use it eventually. One has to account for the fact that over time someone will eventually use the displaced fossil carbon and that all one is doing is buying some time by product substitution. Buying time may be valuable, but the policy implications are far different than when infinite displacement is assumed.

It is also possible that the Commissioner thought the wood products themselves stored more than the forest ecosystem. Most studies, however, even those conducted by the CORRIM group, conclude that the stores in wood products are almost always smaller than that in the ecosystem itself. For short rotation forestry the proportion is about 30-35% wood products and 65-70% ecosystem stores once soil stores are accounted for. And the total store, that is ecosystem plus products, is always lower when the rotation interval is shorter and the harvest is more intensive. Thus, to the extent one argues that wood products will store more than the ecosystem itself, there is no science in support of this conclusion. This was demonstrated in Hudiburg et
In that study, we quantified Oregon’s forest carbon stocks, ran thinning scenarios for bioenergy, forest fire risk reduction, and included substitution benefits of a 50/50 mix of aluminum and steel for housing, assuming forest product demand would increase with the substitution. All of the scenarios in which intensified forest management was simulated (either more clear-cutting or more thinning) resulted in increased CO$_2$ emissions after 90 years, even when forest product substitution and fossil fuel substitution for bioenergy were taken into account. While net emissions started to decrease over the last 30 years of the modeled results, it was not enough to make up for emissions in the first thirty years. This result has very important implications for forest management and overall climate policy given that reducing net emissions in the next 30 years is key to preventing many adverse impacts of climate change to human communities.

The reason why carbon in the ecosystem and in the total forest sector (ecosystem plus products) increases with the rotation interval is actually quite simple: the longer the interval between harvests and the lower the intensity of the harvest, the more carbon that flows into the forest. This is contrary to the common assumption that younger forests are more productive than older-forests. This assumption is based on net input and not gross input to the forest and indeed defines forest productivity as the amount removed from the forest and not added to the forest. To quantify stored carbon, one needs to understand the gross carbon input. This input increases for a landscape as the rotation interval increases. The other reason for the increase in stores with the rotation length is that the time carbon can stay in the system increases as the interval between harvest increases.

In summary, the rate and quantity of carbon stored in forests is already an extremely important policy question for forest managers, legislators, and climate policy professionals. The forest carbon issue has important policy implications for public and private forest management, ecosystem service payment systems, and government policy. We are pleased that you are addressing this important topic. While forests sequester carbon dioxide and the use of forest products replaces the use of more carbon-intensive alternative building materials, it is crucial to use the correct methods of forest carbon accounting. We hope this letter clarifies that longer—not shorter-forest rotations store carbon more efficiently, and that old, un-managed forests are superior carbon sinks than young managed forests.

We would be happy to discuss these important scientific issues with you further.

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