The influence of British Columbia's forests on the carbon dioxide and oxygen balance of the atmosphere

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The threat of global warming due to increasing greenhouse gases in the atmosphere, is of concern to us all. Even though scientists disagree on the magnitude of future climate change, it is important to try to reduce its potential effects, because climate change would have serious impacts on the quality of our global environment.

Carbon dioxide (CO_2) comprises only about 0.03% of the earth's atmosphere. However, it makes a substantial contribution to the greenhouse effect. Atmospheric concentrations of CO_2 have increased by 20% over the last 100 years. Human activities, such as the burning of fossil fuels and tropical deforestation, are major sources of CO_2. In contrast, oxygen (O_2) comprises 21% of the atmosphere and, because of its abundance, atmospheric scientists do not feel that human activities can significantly alter the world's oxygen supply.

CO_2 is cycled between land based ecosystems and the atmosphere, and between ocean based ecosystems and the atmosphere. Through the process of photosynthesis, plants and phytoplankton on land, in oceans, and in lakes, take up CO_2 and give off O_2. In this process carbon is incorporated into living organisms. When these organisms die and decompose, or when they are eaten by animals and used for energy, the carbon is again combined with O_2 from the atmosphere and released as CO_2. In the past, not all of the carbon taken up by organisms has been released back to the atmosphere, but some of it has accumulated as fossil fuels and is now one of our major sources of fuel and of CO_2 emissions.

Two recent articles in Scientific American explain that the earth's oceans take up as much CO_2 as land based ecosystems. These articles indicate that, in global terms, land based ecosystems give off as much CO_2 through respiration and decomposition as they take up through photosynthesis. However, the oceans act as storehouses for CO_2, and a source for O_2, because they absorb more CO_2 than they release.

Forests cover about one-third of the earth's land surface, and contain substantial amounts of carbon in various forms. The world's forests take up and release both O_2 and CO_2. In a forest ecosystem, carbon dioxide is taken up through photosynthesis by trees and other plants, and oxygen is released. The carbon taken up through photosynthesis is stored in the leaves, stems and roots of the plants and trees. Respiration by plants and animals in the forest, and the decay of dead trees, branches, leaves, roots, and animals, releases this carbon back to the atmosphere as CO_2, and removes O_2 from the atmosphere. It is important to note that while photosynthesis occurs only during day light hours, respiration and decay occur continuously. In the northern hemisphere, more CO_2 is taken up than is released in the spring and summer, while the reverse is the case in the fall and winter.

How much carbon a forest gains depends on the age of the forest, and soil and climate conditions. Vigorous young forest ecosystems can take up and store substantial amounts of carbon each year. This is why prompt reforestation after logging helps to reduce the rate of increase in atmospheric CO_2. As a forest ages, carbon accumulates in the trees and in the soil, and the amount of CO_2 released from respiration and decomposition increases. Eventually, the ecosystem reaches a steady state where CO_2 production more or less equals uptake. In an ancient (old-growth) coastal forest, the amount of carbon taken up each year through photosynthesis may equal, or slightly exceed, the amount released by respiration and decomposition.

Where does forestry in British Columbia fit into the CO_2 cycle? A recent analysis indicates that at present, British Columbia's forests are storing 30 million metric tonnes of carbon each year in new wood. Forestry activities can result in a net storage of CO_2 because some of the harvested wood is stored as building materials and other wood products. However, this material will eventually decompose negating much of the original gain. Curtailment of harvesting would result in the loss of the short-term benefits we now realize through the storage of carbon in wood products. Furthermore, there are environmental concerns regarding the production and disposal of materials which might be used as substitutes for wood.

The key to maintaining a favorable carbon balance for our forests is prompt and effective reforestation following harvesting. In British Columbia, legislation requires that Crown forest lands be reforested following harvesting. This contrasts sharply with what is happening in some parts of the world where forests are burned to clear them for agricultural or other uses and new forests are not established. Instead these areas are often converted to shrub and grassland, which are much less effective at storing carbon.

Harvesting of old growth forests is a controversial issue in British Columbia. Arguments have been made both for and against harvesting these forests to maintain a favourable CO_2 balance of the atmosphere. Neither view is correct. It was noted earlier that old-growth coastal forests have at best only a small net annual storage of CO_2. However, converting these forests to vigorous young ones will not gain any ground in combatting increasing atmospheric CO_2.

Ancient forests contain substantial amounts of carbon in the soil, in rotting logs and in other debris. When the forest is harvested, the release of CO_2 through decomposition of this material is accelerated. A young forest takes up CO_2 as it grows. However, it may take 20 years or longer before the amount of CO_2 taken up through photosynthesis exceeds the amount released through respiration and decomposition. It may take over a hundred years before the new forest has recaptured all of the CO_2 which was released following harvesting of the old-growth forest. In the meantime, there is a small gain in carbon storage through the wood products produced after harvest. However these products will eventually decompose. Preharvest levels of stored carbon may be reached in the forest after about 250 years.

Most forest harvesting in British Columbia is not in coastal old growth. Prompt reforestation is allowing British Columbia's forests to be a net sink for CO_2 at present. However, this gain is equivalent to only 25% of the amount of CO_2 produced each year in Canada, and only 0.5% of the CO_2 released annually worldwide.

Continued management of our forests on a sustainable basis is only part of the answer to the problem of global CO_2 emissions. We must deal directly with the source of the problem; we must reduce emissions of CO_2 from fossil fuel combustion and from other sources.