

## Quarterly Theme

**Opportunities for Forest Carbon Management and Carbon Market Participation in New England** - *William S. Keeton, Ph.D., is an Associate Professor of Forest Ecology and Forestry at the University of Vermont. He is co-director of the University of Vermont's Carbon Dynamics Laboratory ([www.uvm.edu/cdl](http://www.uvm.edu/cdl)).*

Cap and trade carbon markets are developing rapidly around the world. This is in response to a rising sense of urgency surrounding climate change and the need to stabilize and then reduce greenhouse gas emissions. The European Carbon Market led the charge, followed in the U.S. by the voluntary Chicago Climate Exchange, the California Registry, and the northeastern Regional Greenhouse Gas Initiative (RGGI). These initiatives have looked to forests as a potential carbon sink and for this reason reward – through revenue generating credits – activities that sequester carbon or otherwise offset emissions. As has oft been stated, forests and forestry are not a silver bullet solution – stabilizing the climate system will absolutely depend on dramatic emissions reductions – but they can help.

However, the more people have explored this possibility, the more they have realized the devil is truly in the details. What seemed at first relatively straightforward is, in fact, exceedingly complicated due to the dynamic nature of carbon storage both in forest ecosystems and in wood products. Determining if forest management actually results in a net increase in carbon storage – as opposed to just a simple increase in rates of uptake – requires accounting for the carbon cost of increased uptake rates (i.e. carbon harvested from a stand to free up growing space) and all of the possible fluxes in and out of both the forest system and the wood products stream over decades or even centuries. And getting the math right is essential. We have to be certain that we are not just changing flux rates (e.g. uptake), but rather increasing net carbon storage in the terrestrial biosphere with associated reductions in carbon dioxide concentrations in the atmosphere.

Perhaps this is why carbon markets first allowed for carbon credits from reforestation or afforestation. This option was certainly the easiest to quantify in terms of carbon sequestration benefits, and was a vital element in climate change stabilization since about 20 to 30% of global greenhouse gas emissions have come from deforestation, mostly in the tropics. More recently the discussion has turned to awarding credits for “avoided deforestation” as another tool for slowing or reversing emis-

sions trends. According to the FAO about 13 million hectares are deforested annually, although net global deforestation rates have decreased from about 8.9 million ha/yr. in the 1990s to 7.3 million ha/yr. over the last decade. Much of this decline relates not to a significant slowdown in tropical deforestation but rather to reforestation/afforestation (including fiber plantations) in eastern Europe, subtropical South America, and elsewhere.

In New England there are fewer opportunities for reforestation since our landscape has largely recovered from 19<sup>th</sup> century clearing. But there are important exceptions. In the Lake Champlain Basin of Vermont, for instance, there are huge opportunities for riparian restoration and these comprise an important component of watershed restoration efforts. While a precise number is not yet available, the total linear area available for riparian forest restoration is at least several hundred kilometers. Restoration of mature forest cover in riparian buffers would represent a sizable carbon sink that might be incentivized, at least in part, through participation in carbon markets. Even avoided deforestation is now relevant, since forest recovery trends in the region turned the corner in the 1990s. In many areas we are now losing more forest from sub-urban and exurban development than is recovering through secondary succession. Hence an opportunity for carbon market participation through land conservation activities and programs.

Most recently carbon markets and the RGGI process have experimented with the idea of awarding credits for a third category of forest carbon sequestration, called “improved forest management.” Steven Ruddell and colleagues made a persuasive argument for this option in the September 2007 issue of the *Journal of Forestry*. IFM carries great potential but will be tricky to pull off. First, we need mechanisms like easements to ensure “permanence” of carbon storage. Next it will be important to certify that IFM does not simply displace carbon losses to other properties (termed “leakage”). And finally there is the challenging issue of how to create and quantify “additionality.” This concept refers to the added carbon storage accrued over time through IMF compared to a “baseline” scenario. The difference between the two is the amount of carbon storage that would qualify for credits. But the proper baseline is still in question. Should this be a business as usual scenario, or a regional average for a specific forest and site type, or a “gold standard” representing best management practices? Each option carries pros and cons in terms of registration and certifica-

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tion, incentives for landowners, and the net carbon storage outcome.

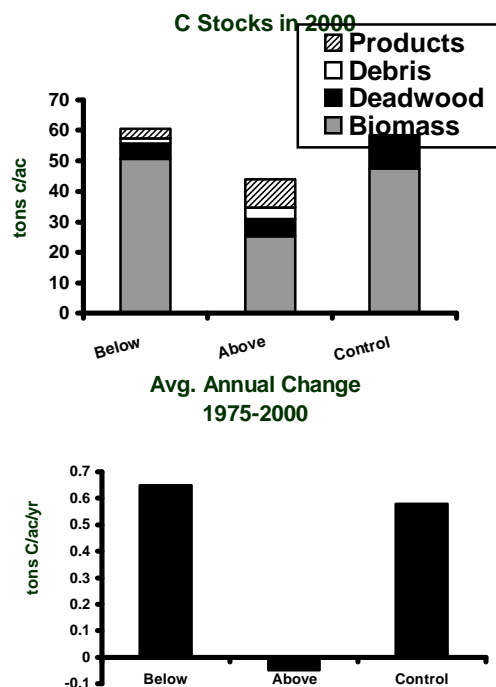
Actively managed forests provide carbon sequestration benefits both within the forest ecosystem and in harvested wood products. Biomass fuel produced as a by-product of forest management activities can help offset greenhouse gas emissions from fossil fuels. On-going research is exploring how to design forest management strategies that optimize storage among these sinks, thereby enabling a landowner to demonstrate additionality. Rapidly growing, younger or well spaced forest stands may have higher rates of carbon uptake, but they have lower biomass per unit area compared to older or less intensively managed forests, and thus actually store less carbon than high biomass forests with lower or stable rates of carbon uptake. Research has shown that as forests age they store more carbon, due to very high levels of accumulated above and belowground biomass. This potential represents an important benchmark for some forest carbon management scenarios, particularly in reserves. Different management approaches, such as frequency (e.g. rotation length) and intensity (e.g. amount of post-harvest structural retention) of stand entry result in different amounts of average carbon storage over the long term. Thus, choice of harvesting approach directly affects not only emissions offsets (i.e. from biomass fuel) but also long-term carbon storage dynamics.

The assumption that harvested wood represents a significant and long-lasting carbon sink can be highly uncertain, depending on product type, processing efficiency, etc. For instance, recently published US Forest Service data show that on average the residency time of carbon declines rapidly and exponentially in products made from both northern hardwood sawtimber and pulp logs. Less than 10% of a tree's carbon remains in use 60 years following harvest, the rest having fluxed to landfills or back to the atmosphere. For this reason, preliminary analyses suggest that intensified regeneration cutting actually reduces net carbon storage. Conversely extended rotations or entry cycles, high levels of post-harvest retention, expanded use of intermediate treatments (thinnings) that enhance biomass accumulation, and practices favoring production of durable wood products may enhance average storage over multiple rotations or entry cycles. These results are preliminary and do not include all possible management scenarios, such as certain types of plantation forestry like high

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est in northwestern Pennsylvania. All stands were thinned to the same relative density, but one stand was thinned from below while the other was thinned strictly from above (the control stand was untreated). The first figure shows the standing stocks of carbon in 2000, while the second shows the average annual change in carbon stocks from 1975-2000 (the stands were thinned twice). This example includes carbon in harvested wood products, as well as standing and down dead wood, although estimating those carbon pools was not discussed here.



So, to sum it up – carbon sequestration is another value of forests than can be considered side-by-side with other management objectives. The key points to remember are: decide which carbon pools you need to measure and whether you want to consider short-term or long-term results. Then, compare your carbon "yield" – average annual change – just as you would any other variable in the management equation.

For more information on the example above, see Hoover, C. M. and Stout, S. L. 2007. The carbon consequences of thinning techniques: Stand structure makes a difference. *Journal of Forestry* 105: 266-270.

For additional reading and useful carbon tools, visit <http://nrs.fed.us/carbon/tools>

## CONNECTICUT – Richard Campbell

**January Meeting** - The CT Chapter held its annual meeting at the Middlesex Extension Center in Haddam, on January 8<sup>th</sup>. The meeting was well attended, with over 50 members present. Following the theme of “Applied Ethics for Forest Practitioners,” three speakers gave talks on issues related to professional ethics and regulations in the field of forestry. Following the chapter business meeting at 11:30 and a quick lunch, chapter chair Ian Branson began the meeting with a welcome and introduction of new officers Valerie O’Donnell and Richard Campbell. Adam Moore, Chairman of the Ad-hoc Committee on CT Forest Practices Regulations and Director CT Forest and Park Association, then spoke on work being done by the Ad-hoc committee to improve forestry regulations within the state. Following this, Doug Emmerthal of the CT DEP Division of Forestry, discussed updates to the Conduct of Connecticut Forest Practitioner Regulations. Finally, Lloyd Irland, Visiting Professor of Forestry at the Yale School of Forestry and Environmental Studies, spoke, comparing the SAF Code of Ethics to the new CT conduct regulations, as well as provided ideas for increasing the stature of professional forestry through stronger ethics mandates and education.

**May Meeting** - The Chapter will hold its summer

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yield biomass farms. However, the science is getting closer to identifying a set of IFM options relevant to working forests in the northern forest region.

Economists have also done their math. A recent paper demonstrated that as carbon credit prices increase, participation in carbon markets may become attractive economically despite opportunity costs (e.g. modified timber harvests) and transaction costs (e.g. certification and enrollment expenses). Where this includes managing for structurally complex, high biomass forests there will be co-varying ecological benefits, such as provision of high quality late-successional wildlife habitats and riparian functionality. In this sense forest carbon management could provide an indicator for other sustainable forestry objectives. Carbon markets will offer one more incentive to keep forests as forests. Forest managers in the 21<sup>st</sup> century will increasingly become carbon managers, and our profession will play a vital role in climate change mitigation efforts.

field meeting on May 29 at Naugatuck State Forest. The Forest was designated as an Important Bird Area by the Audubon Society because of its early successional and young forest habitat created by forest management. Habitat structures to be featured at the meeting include 14-year old clearcuts, final shelterwoods, fields maintained by the use of fire, and powerline right of ways. Thanks to the efforts of the CT DEP Foresters, golden-winged warblers, a State endangered species, have been observed within the last two years, as well as two species of special concern – whip-poor-wills and brown thrashers. For more information and to request a registration form, contact Valerie O’Donnell at [ctsaf\\_sec\\_treas@hotmail.com](mailto:ctsaf_sec_treas@hotmail.com).

**Forest Conservation and Forestry Research Forum** - Plans are underway for the Annual Connecticut Forest Conservation and Forestry Research Forum to be held on November 25, 2008 at the Rome Ballroom on the UConn Campus in Storrs. Look to future articles for further details.



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