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Fall 2005

## Journal Articles

**Beardmore, T., and Whittle, C.-A.** 2005. Induction of tolerance to desiccation and cryopreservation in silver maple (*Acer saccharinum*) embryonic axes. *Tree Physiology* **25**: 965–972.

Twenty percent of the world's flowering plants produce recalcitrant seeds (i.e., seeds that cannot withstand drying or freezing). We investigated whether the embryonic axis from the normally recalcitrant seeds of silver maple (*Acer saccharinum* L.) can be made tolerant to desiccation (10% water content) and low temperature (-196°C, cryopreservation) by pretreatment with ABA or the compound tetcyclacis, which enhances endogenous ABA concentrations. Pretreatment of axes with both ABA and tetcyclacis increased germination after desiccation and freezing to 55% from a control value of zero. Pretreatment of axes with ABA and tetcyclacis increased the ABA content of the axes, as measured by enzyme-linked immunoassay, and stimulated the synthesis of storage and dehydrin-like proteins, believed to have a role in the desiccation tolerance of orthodox seeds.

**Karnosky, D.F., Pregitzer, K.S., Zak, D.R., Kubiske, M.E., Hendrey, G.R., Weinstein, D., Nosal, M., and Percy, K.E.** 2005. Scaling ozone responses of forest trees to the ecosystem level in a changing climate. *Plant, Cell and Environment* **28**: 965–981.

Many uncertainties remain regarding how climate change will alter the structure and function of forest ecosystems. At the Aspen FACE experiment in northern Wisconsin, we are attempting to understand how an aspen/birch/maple forest ecosystem responds to long-term exposure to elevated carbon dioxide (CO<sub>2</sub>) and ozone (O<sub>3</sub>), alone and in combination, from establishment onward. We examine how O<sub>3</sub> affects the flow of carbon through the ecosystem from the leaf level through to the roots and into the soil micro-organisms in present and future atmospheric CO<sub>2</sub> conditions. We provide evidence of adverse effects of O<sub>3</sub>, with or without co-occurring elevated CO<sub>2</sub>, that cascade through the entire ecosystem impacting complex trophic interactions and food webs on all three species in the study: trembling aspen (*Populus tremuloides* Michx.), paper birch (*Betula papyrifera* Marsh.), and sugar maple (*Acer saccharum* Marsh.). Interestingly, the negative effect of O<sub>3</sub> on the growth of sugar maple did not become evident until 3 years into the study. The negative effect of O<sub>3</sub> was most noticeable on paper birch trees growing under elevated CO<sub>2</sub>. Our results demonstrate the importance of long-term studies to detect subtle effects of atmospheric change and of the need for studies of interacting stresses whose responses could not be predicted by studies of single factors. In biologically complex forest ecosystems, effects at one scale can be very different from those at another scale. For scaling purposes, then, linking process with canopy level models is essential if O<sub>3</sub> impacts are to be accurately predicted. Finally, we describe how outputs from our long-term multispecies Aspen FACE experiment are being used to develop simple, coupled models to estimate productivity gain/loss from changing O<sub>3</sub>.

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**Lavigne, M.B., Foster, R.J., Goodine, G., Bernier, P.Y., and Ung, C.H.** 2005. Alternative method for estimating aboveground net primary productivity applied to balsam fir stands in eastern Canada. *Canadian Journal of Forest Research* **35**: 1193–1201.

Aboveground net primary productivity (ANPP) was measured in three balsam fir (*Abies balsamea* (L.) Mill.) forests on a climatic transect extending from southern New Brunswick ("warm" study area) to central Quebec ("cool" study area). Annual foliar production was estimated with a relationship between cross-sectional area at breast height of the current-year annual xylem ring and the mass of current-year foliage, using data obtained by harvesting trees at the beginning of the study. This relationship differed among study areas. Annual branch production was determined from annual foliar production and the ratio of annual branch production to annual foliar production. The ratio of branch to foliar production was estimated from intensive measurement of a sample of branches collected at the end of the study period; it varied among years but was similar for all study areas. ANPP was 3.36 Mg C-ha<sup>-1</sup>year<sup>-1</sup> at the warm study area, 3.73 Mg C-ha<sup>-1</sup>year<sup>-1</sup> at the mid-transect study area, and 3.04 Mg C-ha<sup>-1</sup>year<sup>-1</sup> at the cool study area. These estimates of ANPP were greater than those estimated using a conventional method of summing up increment and litterfall. On average, the conventional estimate of ANPP was 83% of the estimate using relationships described above. Because net ecosystem productivity is the difference between NPP and heterotrophic respiration, a 17% underestimate of NPP can have a substantial effect on the estimate of carbon-sink activity of a forest.

**Lecomte, N., Martineau-Delisle, C., and Nadeau, S.** 2005. Participatory requirements in forest management planning in eastern Canada: a temporal and interprovincial perspective. *The Forestry Chronicle* **81**: 398–402.

With the introduction of the concept of sustainable forest management, the practice of public participation has become omnipresent. This study focuses on provincial participatory requirements in forest management planning (FMP). A comparative framework composed of four participatory process attributes (power, moment of participation, learning/interaction, and procedure) was used to obtain a temporal and interprovincial perspective of Quebec's new participatory process. Our results indicate that with respect to past processes Quebec's current approach allows certain stakeholders, but not the general public, to have more access to FMP. Comparatively, Ontario and Newfoundland have implemented different, clearly stated, approaches that involve the general public at numerous stages of FMP. Future research should concentrate on how these participatory requirements are implemented and on the public satisfaction with regard to this implementation.

**Loo, J.A., and Beardmore, T.** 2005. Butternut may be doomed. *Canadian Silviculture* (Spring): 15.

**Xing, Z., Bourque, C. P.-A., Swift, D.E., Clowater, C.W., Krasowski, M., and Meng, F.-R.** 2005. Carbon and biomass partitioning in balsam fir (*Abies balsamea*). *Tree Physiology* **25**: 1207–1217.

Balsam fir (*Abies balsamea* (L.) Mill.) was extensively sampled to investigate the effects of forest management practices, site location, within-crown position, tree component (i.e., stem, foliage, branches, and roots), and tree social classes on biomass and carbon (C) partitioning at the individual tree level and across ecological regions. The sites were located in three ecologically distinct forest regions of west-central New Brunswick, Canada. There were no significant differences in %C content of trees across ecological regions or across tree social classes. However, at the individual tree level, significant differences were evident in biomass and C allocation between different parts of the tree, between treatment types (i.e., unmanaged and precommercially thinned stands) and between within-crown positions, indicating the need for separate estimates of biomass and C content of tree components to obtain more precise estimates of quantities at the stand level. Calculating stand C content based on constant allocation values, as is commonly done, produced errors of up

to 15% compared with the values calculated in this study. Three allometric equations of biomass and C that account for partitioning among different parts of the tree were developed and compared: (1) a third-order polynomial, (2) a modified inverse polynomial, and (3) a modified Weibull equation. Diameter at breast height (DBH) was used as the only explanatory variable to describe fresh biomass, dry biomass, and C content. All regressions derived showed a high correlation with DBH, with most  $r^2$  values > 0.95. A comparison of the equation results showed that the modified Weibull equation gave consistent results with the best overall fit and was the simplest of the three equations investigated. The regressions can be used to estimate forest biomass and tree C content at the stand level, given specific information on DBH.

## Miscellaneous

**Loo, J.A.** 2005. Importance of setting objectives for biodiversity conservation. Pages 61–62 in B. McAfee and C. Malouin, editors. *Conservation lands: integrating conservation and sustainable management in Canada's forests*. Natural Resources Canada, Canadian Forest Service, Science and Programs Branch, Ottawa, ON.

**Loo, J.A., Basquill, S., and Betts, M.G.** 2005. Maintaining forest community groups at coarse and fine resolutions. Chapter 3 in M.G. Betts and G.J. Forbes, editors. *Forest Management Guidelines to Protect Native Biodiversity in the Greater Fundy Ecosystem*. Pages 27–32. Parks Canada Report. ISBN 1-55131-066-x.

**Loo, J.A., MacDougall, A.S., and Wissink, R.** 2005. Ecologically significant areas. Chapter 7 in M.G. Betts and G.J. Forbes, editors. *Forest Management Guidelines to Protect Native Biodiversity in the Greater Fundy Ecosystem*. Pages 53–60. Parks Canada Report. ISBN 1-55131-066-x.

**Loo, J.A., Beardmore, T.L., Simpson, J.D., and McPhee, D.A.** 2005. Special status species. Chapter 10 in M.G. Betts and G.J. Forbes, editors. *Forest Management Guidelines to Protect Native Biodiversity in the Greater Fundy Ecosystem*. Pages 69–78. Parks Canada Report. ISBN 1-55131-066-x.