

The Sustainability of Forest Residue for Bioenergy in Canada: What can biodiversity tell us?

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Forest Residue



Tree-length Harvest



Residue Roadside Piles



Interest in using forest biomass is high

- Reduction in greenhouse gas emissions
- New jobs in energy and forestry sector
- Diversification of Canadian energy portfolio



Context

- **A National Scan of Regulations & Practices Relevant to Biomass Harvesting 2010.** World Wildlife Fund- Forest Products Association of Canada.
- **eNGO and Conservation Group Outreach on Biomass: Position and rationale regarding the use of biomass for electricity/heat production.** Dagg et al. 2011 Pembina institute.
- **Fuelling a BioMess: Why burning trees for energy will harm people, the climate and forests.** 2011. Greenpeace.



Dagg et al. 2011

“It is the opinion of many organizations that forest residue is not an acceptable biomass resource. This material is essential for biodiversity, wildlife habitat, soil fertility and forest productivity”



Estimates of CWD volume

Stand	Managed (m ³ /ha)	Unmanaged (m ³ /ha)
Ontario (upland conifer) (Parton 2013)	15.21 (21-50%)	30.3, 34.1, 73.4
Ontario (Pj) (Parton 2013)	9.81 (47%)	20.8
BC (Densmore 2011)	78.8-167% of unmanaged	
BC (Densmore 2011)	4.4-80 % of CWD large pieces of unmanaged	
Sweden (Fridman and Walheim 2000)	0.5-11 (2-15%)	11-91
Fennoscandia(1-140 yrs) (Siitonen 2001)	2-10 (2-17%)	60-90
Fennoscadina >140 yrs (Siitonen 2001)	15.9 (18-27%)	60-90



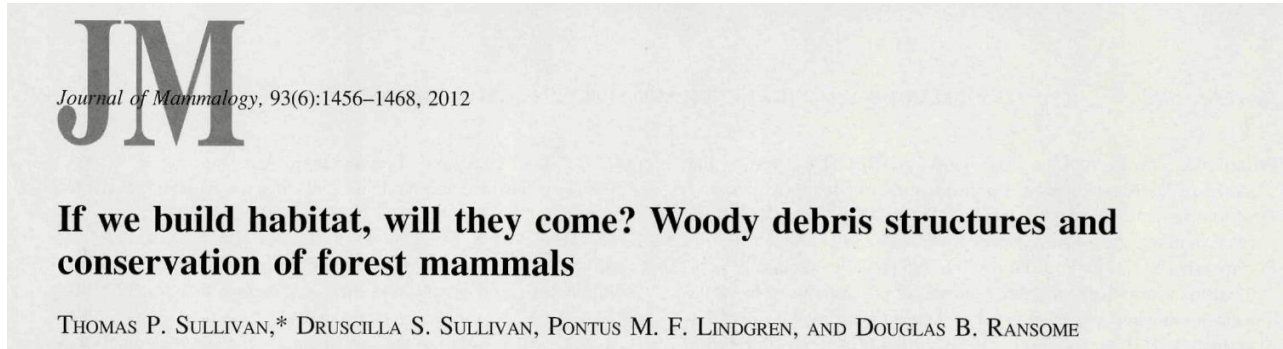
Biodiversity and deadwood

- Northern Europe has hundreds of red listed species associated with deadwood while Canada does not
- Quantity and quality is important
- Examples
 - High bryophyte and rove beetle diversity in late decay logs (Cole et al. 2008, Buddle et al. 2006)
 - Insect species composition changes with decay class (Vanderwel et al. 2006)
 - Decay class and log diameter are important predictors of suitable foraging substrate for Black-backed Woodpeckers (Tremblay et al. 2009)



Review of some Canadian Literature...

Mammals



- Red-backed voles and weasels were more abundant in piles.
- Removal of deadwood limits management options for mammals.



Birds

Research Papers

Habitat Requirements of Breeding Black-Backed Woodpeckers (*Picoides arcticus*) in Managed, Unburned Boreal Forest

Besoins en termes d'habitat chez le Pic à dos noir (*Picoides arcticus*) nichant en forêt boréale non brûlée et sous aménagement

*Junior A. Tremblay*¹, *Jacques Ibarzabal*², *Christian Dussault*¹, and *Jean-Pierre L. Savard*³

Avian Conservation and Ecology 4(1): 2 online <http://www.ace-eco.org/vol4/iss1/art2/>

- Threshold of 35m³/ha of deadwood
- 15m³/ha early decay class
- Majority of foraging on recently dead snags



Macro-arthropods

Stand composition and structure of the boreal mixedwood and epigaeic arthropods of the Ecosystem Management Emulating Natural Disturbance (EMEND) landbase in northwestern Alberta¹

Timothy T. Work, David P. Shorthouse, John R. Spence, W. Jan A. Volney, and David Langor

Canadian Journal of Forest Research 34: 417-430 (2004)

Forest Ecology and Management 321 (2014) 19-28



ELSEVIER

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Forest Ecology and Management

journal homepage: www.elsevier.com/locate/foreco



Reductions in downed deadwood from biomass harvesting alter composition of spiders and ground beetle assemblages in jack-pine forests of Western Quebec

Timothy T. Work^{a,c,*}, Suzanne Brais^{b,c}, Brian D. Harvey^{b,c}



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Macro-arthropods

ZooKeys 258: 31–52 (2013)
doi: 10.3897/zookeys.258.4174
www.zookeys.org

RESEARCH ARTICLE

A peer-reviewed open-access journal
ZooKeys
Launched to accelerate biodiversity research

Initial responses of rove and ground beetles (Coleoptera, Staphylinidae, Carabidae) to removal of logging residues following clearcut harvesting in the boreal forest of Quebec, Canada

Timothy T. Work¹, Jan Klimaszewski², Evelyne Thiffault², Caroline Bourdon², David Paré², Yves Bousquet³, Lisa Venier⁴, Brian Titus⁵



Quedius labradorensis



Available online at www.sciencedirect.com

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Forest Ecology and Management 225 (2006) 190–199

Forest Ecology
and
Management

www.elsevier.com/locate/foreco

Insect community composition and trophic guild structure in decaying logs from eastern Canadian pine-dominated forests

Mark C. Vanderwel^{*}, Jay R. Malcolm, Sandy M. Smith, Nurul Islam



k5216060 www.fotosearch.com



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ECOSPHERE

Estimating species loss of saproxylic insects under scenarios
of reduced coarse woody material in eastern boreal forests

TIMOTHY T. WORK^{1,2,†} AND ANNIE HIBBERT²

Volume 2(4) Article 41



Microbes

The ISME Journal (2012) 6, 2199–2218
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www.nature.com/ismej



ORIGINAL ARTICLE

Significant and persistent impact of timber harvesting on soil microbial communities in Northern coniferous forests

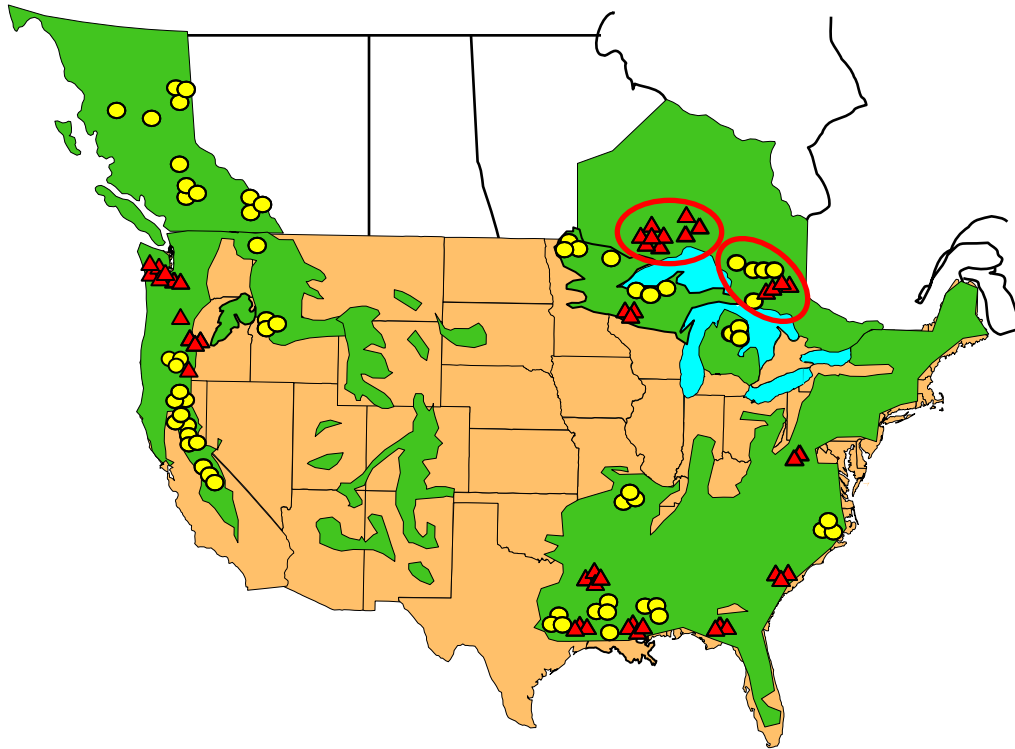
This article has been corrected since Advance Online Publication and a corrigendum is also printed in this issue.

Martin Hartmann^{1,7}, Charles G Howes¹, David VanInsberghe¹, Hang Yu^{1,8}, Dipankar Bachar^{2,3}, Richard Christen^{2,3}, Rolf Henrik Nilsson^{4,5}, Steven J Hallam^{1,6} and William W Mohn¹

More than a decade after harvesting, diversity and structure of soil fungal communities remained significantly altered by different levels of organic material removal but differences were small.



LTSP design and intensive forest biomass removals



Powers 2006. Long-term soil productivity: genesis of the concept and principles behind the program. CJFR

- Conceptual model - organic matter a major variable regulating soil processes affecting productivity
- Modification of site organic matter is a main effect treatment
- Long-term forest growth measurements
- Pre- and post-harvest measurements of site C and nutrient pools that enable accurate determination of site removals and retention



LTSP treatments



- Targeted infertile coarse textured and shallow soils
- 14 sites, mature 60-125 year-old boreal stands – Pj and Sb
- Harvest treatments tree-length (TL), full-tree harvest (FT), full-tree harvest and forest floor removal (FFR) – 30m X 30m plots X 3 replicates/site
- Sites replanted – NE Pj, NW Sb



Mature Control



Tree Length Harvest



Whole Tree Harvest



Forest Floor Removal (Bladed)



LTSP Biodiversity work

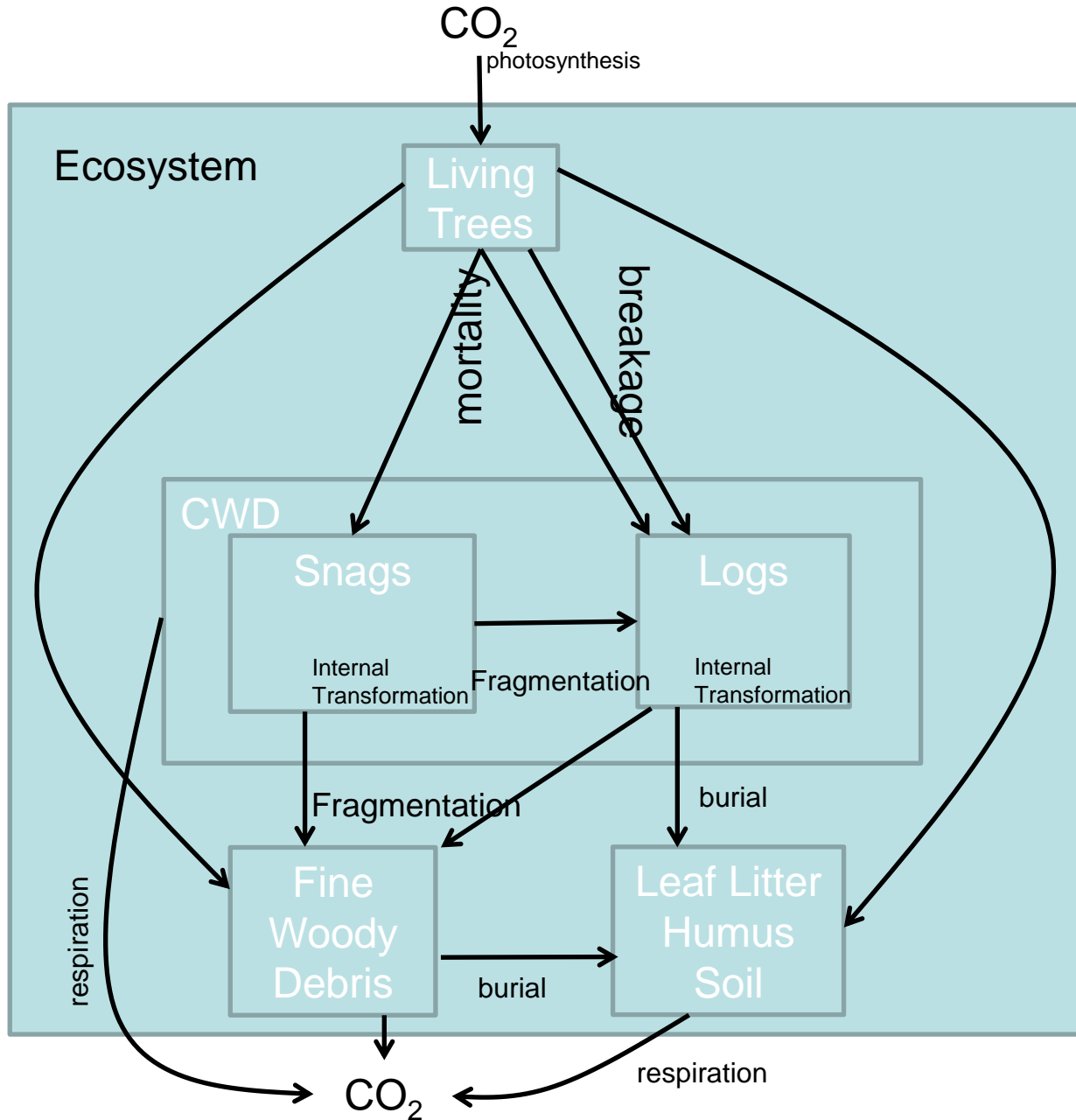
- Mohn et al. Soil microbial communities;
University of British Columbia
- Berch et al. Soil fauna (collembola and mites)
BC Ministry of Forests
- Venier, Rousseau et al. Soil fauna (collembola
and mites) Canadian Forest Service and
University of Quebec at Montreal



Dead wood as a surrogate for biodiversity

- British Columbia Forest and Range Evaluation Program
- Data collected from 2006-2009
- Comparison of dead wood in uncut retention patches and harvested areas in 3 forest regions (18 biogeoclimatic subzones)
- Volume of CWD left on harvested sites was similar or higher than within retention patches
- Density of large pieces of CWD (≥ 20 cm diameter and ≥ 10 m long) is significantly lower
- No direct measures of biodiversity



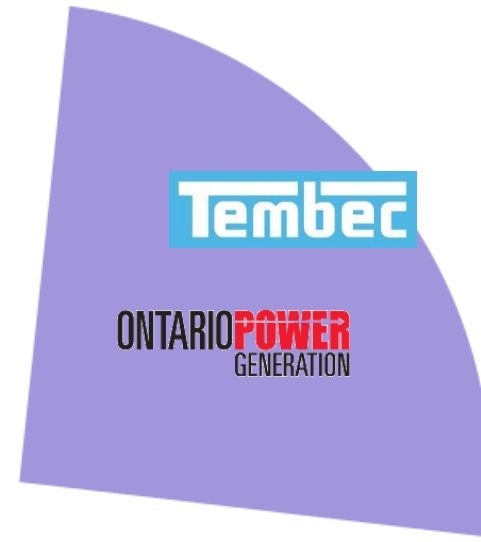


Collaborative science: multi partnership; Island Lake and Forêt Montmorency

Forest communities & First Nations



Industries



Government agencies

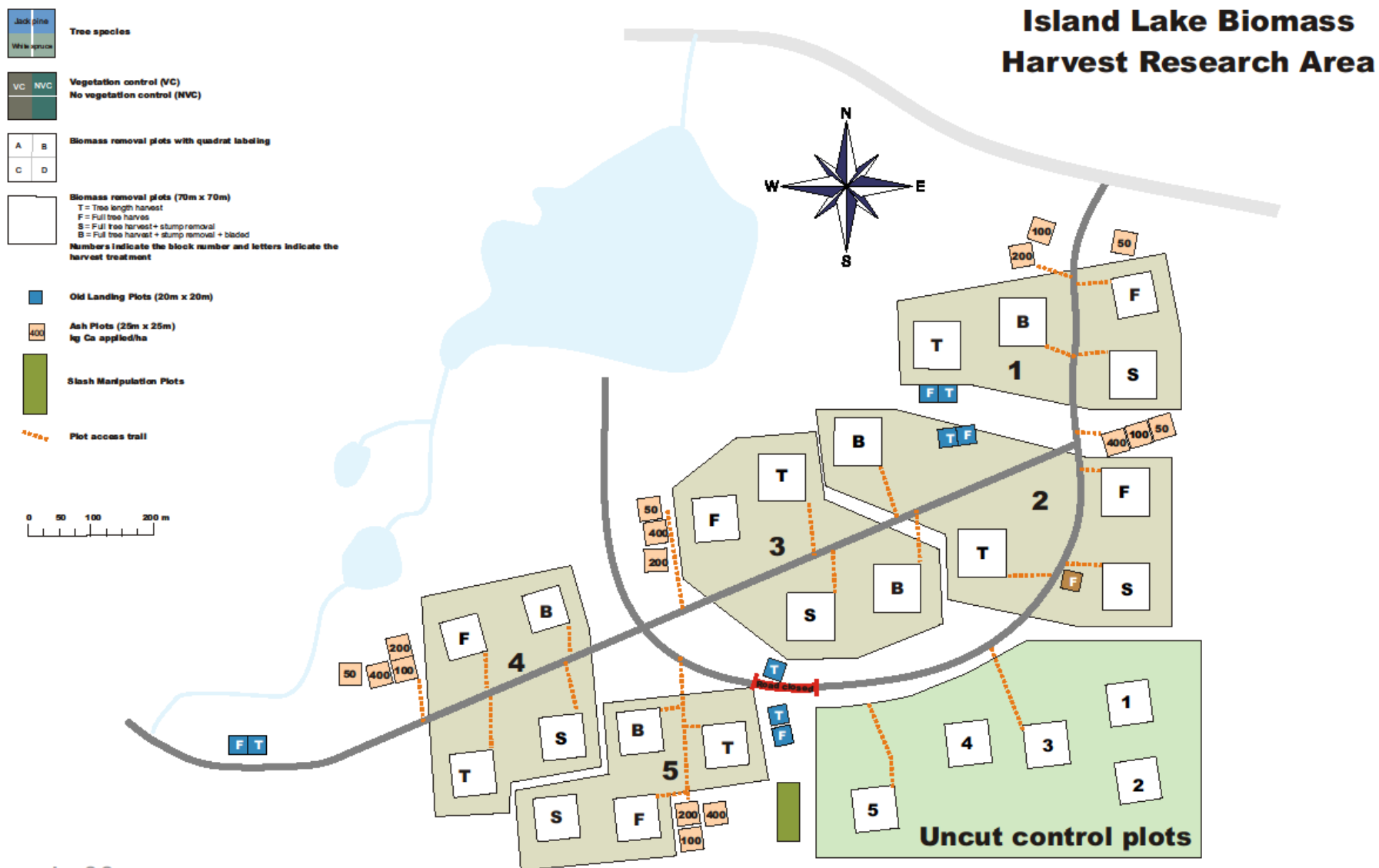


Universities









version 2.2



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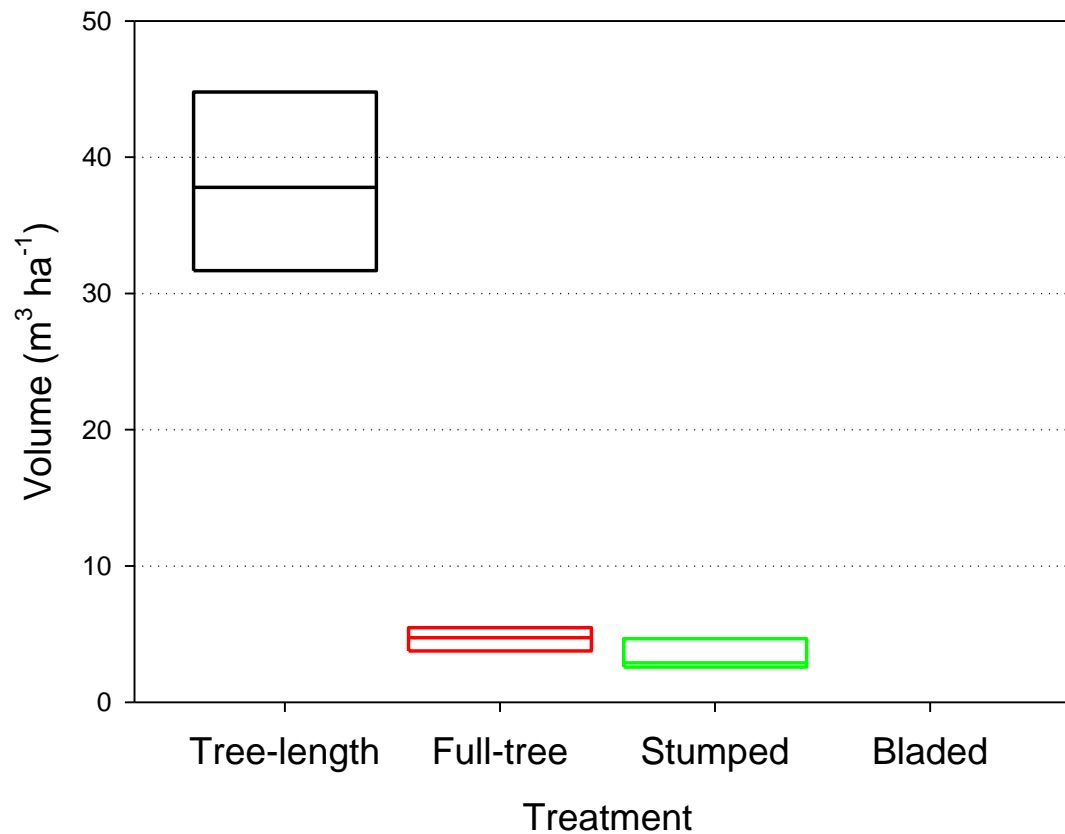
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Island Lake Biomass Research and Demonstration Area

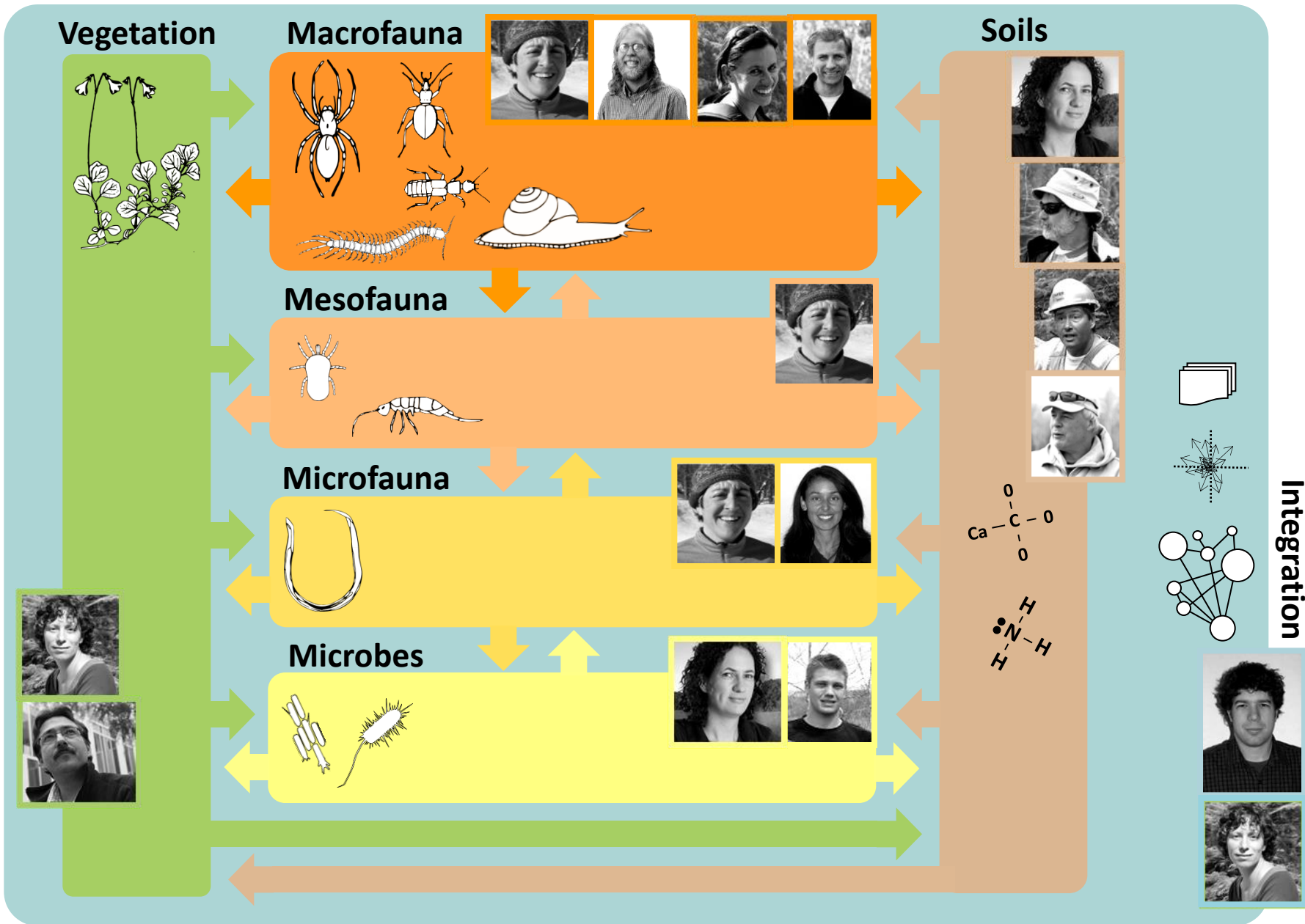


Island Lake post-harvest coarse wood (all aboveground > 5 cm diameter)





Island Lake Project



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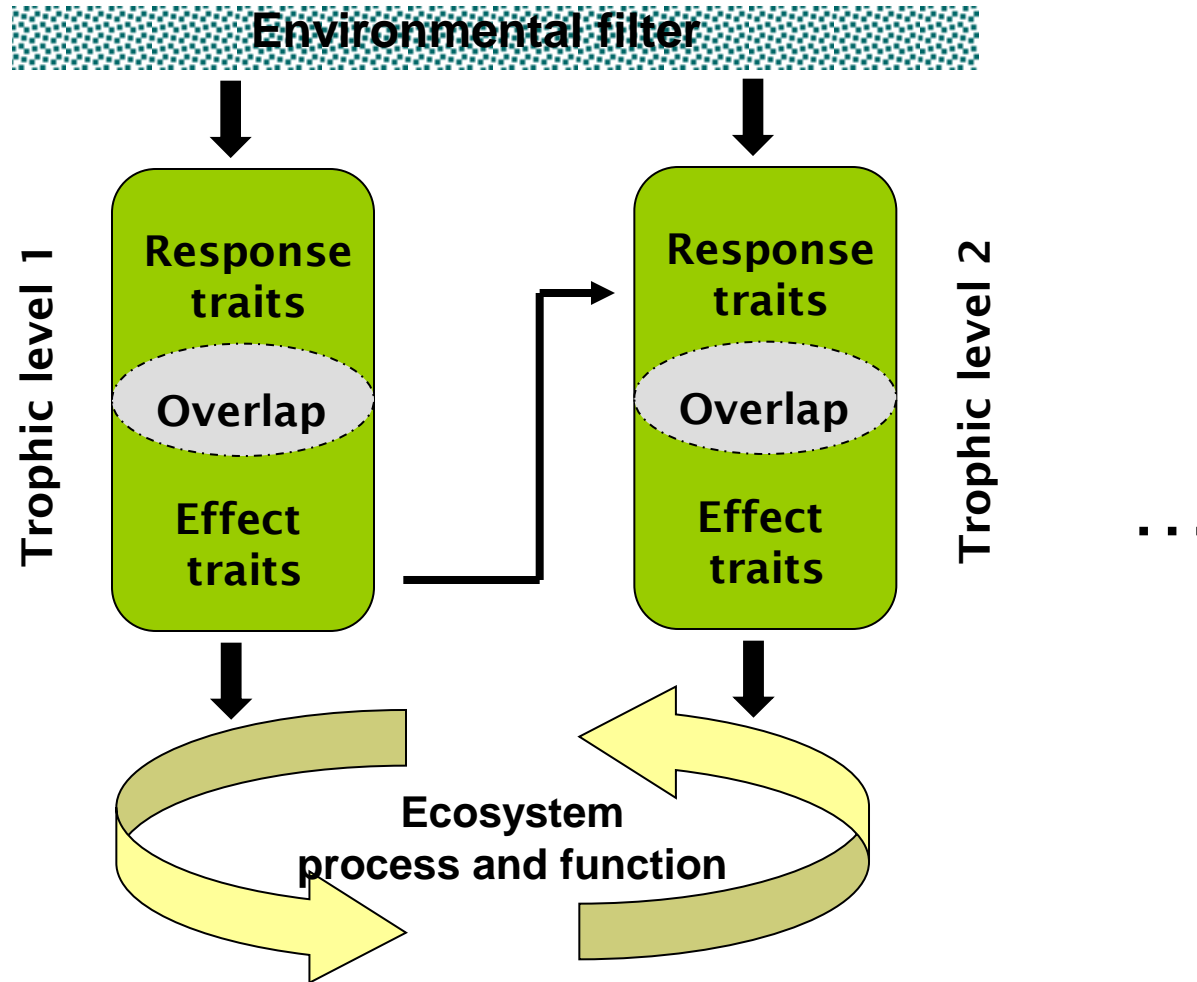
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Image sources for this figure: bumblebee.org; plants.usda.gov; Borror and White (1970) Peterson Field Guide to the Insects of America North of Mexico

Canada

Integration

Multi-trophic scale project



Lavorel & Garnier 2002. *Funct. Ecol.*
Moretti et al. submitted



Conclusions



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- Work on sustainability of biomass removal based on biodiversity is in early stages in Canada especially relative to work on soil and tree productivity.
- There is much interest in thresholds of biomass removal or the corollary of how much biomass needs to be left on site to be sustainable. Studies to address this question are preliminary to date but ongoing.



Conclusions



- Most work to date has looked at short-term impacts. There are some opportunities with the LTSP network to examine longer – term impacts but only for species that operate at very small scales.
- Biomass inventories are being suggested and used as surrogates for biodiversity because of the difficulty of monitoring biodiversity. A related idea is the modelling of deadwood to provide long-term predictions of biomass availability relative to forest type and disturbance or harvesting approaches.
 - Direct links between biodiversity and deadwood quantity and quality will still need to be made using experimental approaches

Questions?

