

Assessing Deadwood Using Harmonized National Forest Inventory Data

Jacques Rondeux, Roberta Bertini, Annemarie Bastrup-Birk, Piermaria Corona, Nicolas Latte, Ronald E. McRoberts, Göran Ståhl, Susanne Winter, and Gherardo Chirici

Abstract: Deadwood plays an important role in forest ecological processes and is fundamental for the maintenance of biological diversity. Further, it is a forest carbon pool whose assessment must be reported for international agreements dealing with protection and forest management sustainability. Despite wide agreement on deadwood monitoring by national forest inventories (NFIs), much work is still necessary to clarify definitions so that estimates can be directly compared or aggregated for international reporting. There is an urgent need for an international consensus on definitions and agreement on harmonization methods. The study addresses two main objectives: to analyze the feasibility of harmonization procedures for deadwood estimates and to evaluate the impact of the harmonization process based on different definitions on final deadwood estimates. Results are reported for an experimental harmonization test using NFI deadwood data from 9,208 sample plots measured in nine European countries and the United States. Harmonization methods were investigated for volume by spatial position (lying or standing), decay classes, and woody species accompanied by accuracy assessments. Estimates of mean plot volume based on harmonized definitions with minimum length/height of 1 m and minimum diameter thresholds of 10, 12, and 20 cm were on average 3, 8, and 30% smaller, respectively, than estimates based on national definitions. Volume differences were less when estimated for various deadwood categories. An accuracy assessment demonstrated that, on average, the harmonization procedures did not substantially alter deadwood observations (root mean square error 23.17%). *FOR. SCI.* 58(3):269–283.

Keywords: reference definitions, bridging functions, deadwood attributes, biodiversity indicator, carbon pool

DEADWOOD IS ACKNOWLEDGED TO BE A CRITICAL ECOLOGICAL FACTOR that plays a fundamental role in forest ecosystems (e.g., Christensen et al. 2005, Lombardi et al. 2010). It is one of the most relevant components of forest biodiversity, and it represents an important forest carbon pool (Stokland et al. 2004, Woodall et al. 2009). Dead trees, stumps, and fine and coarse woody debris (CWD) are essential to forest ecosystem dynamics by providing food and habitat for taxa such as fungi, arthropods, birds, insects, and epiphytic lichens (Sippola and Renvall 1999, Bowman et al. 2000, Ferris et al. 2000, Siitonen et al. 2000, Similä et al. 2003, Jonsson et al. 2005, Odor et al. 2006, Lonsdale et al. 2008, Winter and Möller 2008). Approximately 20–25% of forest species depend on

decaying wood (Boddy 2001, Siitonen 2001), although decayed material is often viewed as a limited habitat resource for some organisms (Hagen and Grove 1999).

Deadwood is also considered to be an important indicator for assessing sustainable forest management and conservation of forest biodiversity (Ferris and Humphrey 1999, Hahn and Christensen 2004, Travaglini et al. 2007, Fischer et al. 2009). Deadwood was recognized as a biodiversity indicator for sustainable forest management by Forest Europe, the former Ministerial Conference on the Protection of Forests in Europe (2003), and the Montréal Process (Montréal Process 2005) and as one of 26 indicators selected for the Streamlining European 2010 Biodiversity Indicators initiative to track temporal biodiversity changes in the context

Manuscript received May 25, 2010; accepted September 27, 2011; published online May 3, 2012; <http://dx.doi.org/10.5849/forsci.10-057>.

Jacques Rondeux, University of Liège, Gembloux Agro-Bio Tech, Unit of Forest and Nature Management, Passage des Déportés 2, Gembloux, Namur 5030, Belgium—Phone: 00 32 81 62 22 28; jrondeux@ulg.ac.be. Roberta Bertini, Università degli Studi di Firenze—bertini.roberta@gmail.com. Annemarie Bastrup-Birk, University of Copenhagen—ab@life.ku.dk. Piermaria Corona, Università degli Studi della Tuscia—piermaria.corona@unitus.it. Nicolas Latte, University of Liège, Gembloux Agro-Bio Tech, Unit of Forest and Nature Management—nicolas.latte@ulg.ac.be. Ronald E. McRoberts, US Forest Service, Northern Research Station—rmcroberts@fs.fed.us. Göran Ståhl, Swedish University of Agricultural Sciences—goran.stahl@srh.slu.se. Susanne Winter, Technische Universität München—winter@wzw.tum.de. Gherardo Chirici, Università degli Studi del Molise—gherardo.chirici@unimol.it.

Acknowledgments: This article is based on the activities carried out in WG3 of COST Action E43 “Harmonisation of National Forest Inventories: Techniques for Common Reporting.” We express our thanks to the chair of COST Action E43, Professor Erkki Tomppo, to the members of the steering committee (Klemens Schadauer, Emil Cienciala, Adrian Lanz, and Claude Vidal) and to those who were involved in the activities of WG3: Iciar Alberdi Asensio, Anna-Lena Axelsson, Anna Barbat, Nadia Barsoum, Jana Beranova, Urs-Beat Brändli, Vladimir Caboun, Catherine Cluzeau, Sebastiano Cullotta, Leandras Deltuva, Paulo Godinho-Ferreira, Nabila Hamza, Elmar Hauk, Albertas Kasperavičius, Marko Kovač, Marco Marchetti, Helena Mäkelä, Stefan Neagu, Jan-Erik Nilsen, Dieter Pelz, Tarmo Tolm, Tiina Tonteri, and Theocharis Zagas. For contributing deadwood data for the common DB, we gratefully acknowledge the following: Belgium: Jacques Rondeux and Nicolas Latte, Unit of Forest and Nature Management, University of Liège (Gembloux Agro-Bio Tech); Switzerland: Urs-Beat Brändli and Ulrich Ulmer, Snow and Landscape Research (WSL), Swiss Federal Institute for Forest; Germany: Heino Polley, Johann Heinrich von Thünen-Institut, Eberswalde; Denmark: Annemarie Bastrup-Birk and Thomas Nord-Larsen, Forest and Landscape, University of Copenhagen; Spain: Roberto Vallejo, Ministerio de Medio Ambiente y Medio Rural y Marino, and Iciar Alberdi Asensio and Sonia Condés, E.T.S.I. Montes de Madrid; Finland: Helena Mäkelä, Finnish Forest Research Institute, Metla; Italy: Marco Marchetti, University of Molise; Sweden: Jonas Fridman and Anna-Lena Axelsson, Swedish University of Agricultural Sciences; United States of America: Forest Inventory and Analysis program of the Northern Research Station, US Forest Service. We acknowledge Alessandro Mastroratti (www.gm-studio.net) for the graphical three-dimensional rendering in Figure 2. We thank the associate editor of *Forest Science* and two anonymous reviewers who help us in improving the quality of an earlier draft of this article. This study was partially supported by the Italian Ministry of Research and University within the PRIN 2007 project “Innovative methods for the identification, characterization and management of old-growth forests in the Mediterranean environment.”

Copyright © 2012 by the Society of American Foresters.