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Safeguarding species richness vs. increasing the use of renewable energy—The effect of stump harvesting on two environmental goals

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ABSTRACT

Deadwood is recognized as one of the most important resources affecting forest biodiversity. Its absence from the forest landscape is, therefore, of concern, such that one official Swedish environmental objective is to increase the volume of deadwood. However, increasing the use of renewable energy sources, another environmental goal, is likely to work against this biodiversity objective. In this study we utilize a regional economic forest sector model, focusing on northern Sweden, in order to estimate the effect of a large scale introduction of stump harvest on the future use of forest fuel. In addition, an ecological model, describing the relationship between the availability of stumps and the abundance of saproxylic beetles, is linked to the economic model.

The parameters used in the economic model are derived from a data set spanning 28 years while the ecological model is derived from a survey of ten clear cuts, undertaken seven years after the clear cutting, in order to investigate the abundance of saproxylic beetles in stumps. We simulate the effects of an increased demand for wood fuels in northern Sweden, with or without stump harvest. The two scenarios have different effects on all major round wood markets in the region, as well as on the abundance of saproxylic beetles. More specifically, the harvest of stumps is associated with a 5% reduction in the mean abundance of saproxylic beetles living

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in deadwood on future clear cuts and a 3% increase in the use of renewable energy recourses in heating plants.

Introduction

The main objective of this study is to analyze the goal conflict between two Swedish environmental objectives: *Reduced Climate Impact* and *A Rich Diversity of Plant and Animal Life*. The presence of potential goal conflicts has implications for both target-setting and the measures taken to deliver the objectives. A standard cost–benefit analysis, disregarding the effects of one goal on the other, would, therefore, be biased.

Apart from the use of forest resources to provide raw materials to the forest industry, forests are an important source of energy and a habitat for many different forest species. Forests constitute a key renewable energy resource in Swedish energy and climate policy. This aspect of the forest resource will become increasingly important for many reasons, but particularly due to the EU targets concerning reductions in greenhouse gas emissions and the amount of energy that should be generated from renewable energy sources. At the same time, concerns regarding biodiversity have also received increased interest, and have resulted in policy actions at all levels, from the local to the global.

Forest land is key in maintaining biodiversity, particularly in Sweden, with forests covering 68% of the total land area. However, intensive forestry threatens an increasing number of forest species. In Sweden, approximately 50% or 2131 of the red listed species are considered to be forest-dwelling (Gärdenfors, 2010). One of the most important factors for sustaining a rich biodiversity in the boreal forest landscape is the presence of deadwood (e.g., Berg et al., 1994; Jonsell et al., 1998; Siitonen, 2001). Indeed, a large proportion of the species in boreal forests depend directly or indirectly on this resource (Hanski and Hammond, 1995; Siitonen, 2001; Speight, 1989). About 90% of the Swedish red-listed species that are dependent on it are confined to coarse woody debris (CWD, defined as deadwood with a diameter exceeding 10 cm). Forest management in Fennoscandia has decreased the volume of CWD to 2–30% (normally less than 10% on average) of the amount present in the remaining small patches of unmanaged, old-growth boreal forest in the region (Fridman and Walheim, 2000; Siitonen, 2001; Stenbacka et al., 2010). Consequently, efforts to enhance the conditions for such species have focused on preserving and creating CWD in the forest landscape (Dahlberg and Stokland, 2004; Gibb et al., 2006; Hjältén et al., 2007).

In June 2009, the Swedish parliament decided on a new climate policy action plan, aiming to reduce greenhouse gas emissions from activities not included in the EU Emissions Trading Scheme by 40% between 1990 and 2020. This target is part of a plan that includes the goal of generating 50% of all energy used in Sweden from renewable resources by 2020. In 2010, the share of renewable energy was 47.9%.

Power and district heating plants with the potential for substituting or selecting fuel have largely abandoned fossil fuels in favor of renewable energy sources. A large part of this shift can be attributed to the increased use of forest fuels. In total, forest fuels only accounted for 0.3 TWh, or less than 1% of total input in 1980, rising to 21 TWh, or almost 40% of the total energy input by 2010 (Swedish Energy Agency, 2010). Available forecasts (e.g., Swedish Energy Agency, 2007) suggest that demand for biofuels, especially forest fuels, will increase in the future.

As shown by Ankarhem et al. (1999), the Swedish market for forest fuels is closely linked to the markets for other wood assortments (see Ankarhem, 2004 and Geijer et al., 2011 for more examples). This implies that as demand for biofuels increases, competition for raw material will also increase. To avoid this dilemma, and still boost the supply of raw material for forest fuel, tree stump harvesting has been suggested (e.g., the Swedish Government Bill, 2007/08:108, and Swedish Forest Agency, 2009). The main inspiration for stump harvesting in Sweden, where it is currently only undertaken on a small scale, is Finland. In Sweden, stumps were harvested from 10, 500, 1100 and 1400 ha, respectively, in