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WHERE IS OUR CERTIFIED FOREST? APPLICATION OF A NEW TOOL FOR CERTIFICATION MAPPING TO THE BOREAL FOREST.

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SUMMARY
About 10% of the global forest area has been certified by mid-2014. During the past 2 decades, forest management certification also became a tool to support a transition to and ensure sustainable forest management. However, the speed of certification has slowed down and there is an uneven split of the certified area with the majority located in the northern hemisphere. This article aims at providing a methodology for spatially explicit assessment of the global certified forest with special emphasis on the boreal domain in order to help not only monitoring past progress and current performance, but also identifying possible future developments. Results indicate that knowledge of certified forest locations is key to develop certification also into a monitoring and verification tool for important international agreements e.g. on carbon sequestration or deforestation reduction.

INTRODUCTION, BACKGROUND AND OBJECTIVES

Forest management has multiple objectives and is of vital importance for the greenhouse gas balance and for human health amongst other aspects. However, there are conflicts between the different uses of forests like timber production, recreation, habitat for biodiversity, water management, reindeer husbandry, rights of indigenous people and local communities, just to mention a few of the main conflict topics. To capture all different functions and uses of forests and balance them, the concept of sustainable forests was developed. The failure of the United Nations Rio Summit to agree upon a forest convention on sustainable forestry, inspired the first private certification schemes to start in 1993 (Rametsteiner and Simula 2003). Consequently, forest certification was initially pushed by environmental groups to address concerns about deforestation and forest degradation and to promote the maintenance of biodiversity. From there, it developed to become a tool for the implementation of sustainable forest management. Many certification schemes have since emerged, 2 of which are clearly dominant: the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC).

Much has been published on comparisons and assessments between the two schemes (e.g. Gulbrandsen 2005, Romero et al 2013). A long list of literature concentrates on certification and environmental governance, performance, ecosystem services, as well as trust and cooperation between relevant NMO's and forest owners (see inter alia: Visseren-Haemakers and Pattberg 2013, Roberge et al 2011, Meijard et al 2014, Johansson et al 2013, Elkabaidze et al 2011, Gulbrandsen 2008). Other authors have investigated the questions of price premium for certified timber, the consumer awareness and sustainability in the production chain, or conducted cost-benefit-assessments of certification as a market-based tool for forest products (e.g.: Kraxner et al 2009, Fernholz and Kraxner et al 2013, Eriksson et al 2007, Hansen et al 2006, Ebeling and Yasue 2009, Cubbage et al 2010, Bouslah et al 2010). Some of the literature also tackles the attitudes of the public and forest owners towards certification and sustainable forest management (c.f. Rametsteiner and Kraxner 2003, 2009, Chen et al 2010, 2011, Creamer et al 2012). Only a few authors tried to carry out empirical studies that investigated whether certification can save tropical biodiversity, for example (cf. Rametsteiner and Simula 2003, Visseren-Haemakers and Pattberg 2013, Romero et al 2013), or whether certification has led to better and sustainable forest management (e.g. Masters et al 2010, Klooster 2010, Cashore et al 2006). However, many of the authors agreed in the fact that there is insufficient empirical evidence on the impacts of certification to generate lessons learned on a global scale. While several published reviews of forest management certification provide some guidance for future work, most were based on geographically limited case studies, indirect information and were not conducted by independent observers. Furthermore, it has been stressed that for a proper evaluation it is critical to understand the national and local contexts (social, political, biophysical and economic) that affect the implementation and ultimate permanence of certification impacts in a given forest. The mentioned articles concluded that there is need for more studies of certification to know more about both the local and global impacts.

When revisiting the original and publicly available data from the two main certification bodies (FSC, PEFC), it soon becomes clear that the data available from the individual webpages cannot satisfy scientific approaches. As an example the global certification maps by FSC and PEFC (2014) are shown respectively in the left and right panels of Fig. 1. Both follow the assumption that sufficient information can be gleaned from aggregate country-level certification shares irrespective of the forest area and the corresponding difference between managed and unmanaged areas. However, to address the questions of whether certification can be used for a tracking and monitoring tool for illegal logging or biodiversity conservation projects, for example, information at much higher resolution would clearly be needed.

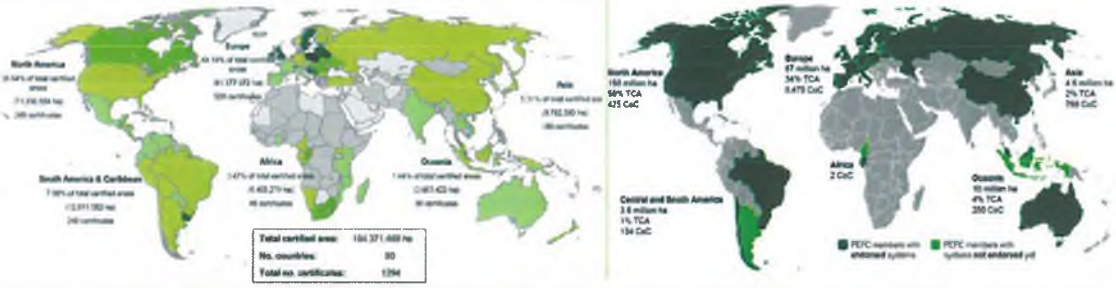

Figure 1: Global certification map by FSC (left), indicating the relative shares of certified forest area with the help of a color ramp. Global certification map by PEFC (right), indicating certification shares of countries (numbers) and membership status (different green color). Source (FSC, PEFC 2014)

In general, there is only very limited useful and reliable statistical data available that would allow for carrying out empirical studies in order to assess the past, present and future development of certification. The United Nations Food and Agriculture Organization (FAO) together with the Economic Commission for Europe (FAO/UNECE) provides a unique chapter on certified forest products in their Forest Products Annual Market Review (e.g. Fernholz, Kraxner et al. 2014), which can be seen as the only official and independent data repository for forest management certification. By May 2014 the major global certification schemes – FSC and PEFC – reported a total gross area of 440.3 million hectares (Fig. 2) under their individual (endorsed) certification standards. The PEFC has endorsed 258 million hectares of certified forest land in 28 countries; whereas the FSC has certified a total of 182 million hectares in 81 countries (Fernholz and Kraxner et al. 2014).

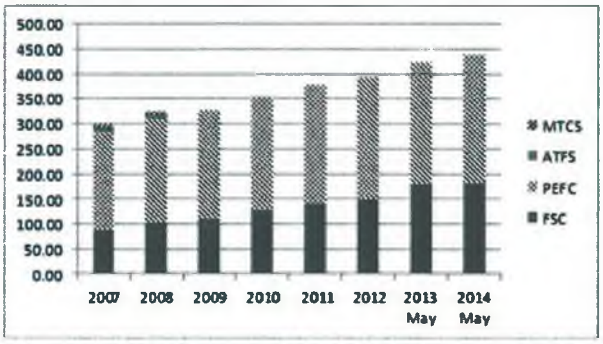

Figure 2: Forest area certified by major certification schemes 2007-2014, in million hectares by year and scheme. Source: modified after Fernholz and Kraxner et al. (2014)

Even though the spread of certified forest area has increased almost exponentially during many years, about 90% of the globally certified area is located in the northern hemisphere (Fig. 3). This might indicate the success of forest management certification in northern regions such as Europe or North America. However, forest certification has still not become established in the Southern Hemisphere with its abundant tropical and sub-tropical forest areas that are especially exposed to threats of deforestation and degradation.

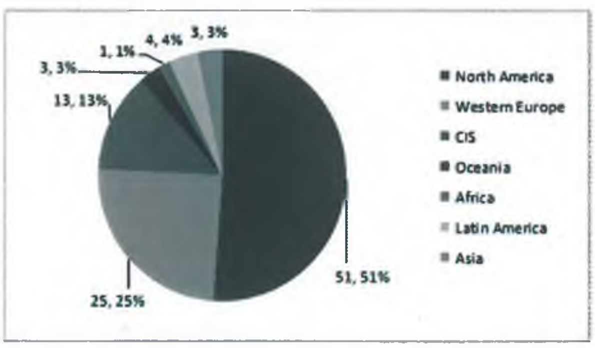

Figure 3: Total certified forest area by regional share (2014). Source: modified after Fernholz and Kraxner et al. (2014)

In the same publication series, Kraxner et al. published already in 2008 a first geographically explicit attempt to improve the visualization and data evidence of global forest management certification taking advantage of the finding by Rametsteiner and Simula (2003) that the basic criteria and indicators used by FSC and PEFC were very much comparable. While this work represents a major step into the right direction, there is clearly scope for improvement, which is the first main objective of this study. In order to achieve this aim a more sophisticated downscaling algorithm has been developed, which is described in more detail below. The new map resulting from this application with special focus on the boreal forest constitutes the first contribution of this study. With this, we can more precisely answer our question of where exactly our certified forest is. The second objective is to investigate how certification can contribute to the preservation of intact forests and to derive corresponding policy recommendations. This research question is tackled by combining the results from the first objective with additional layers of geographically explicit information on protected areas and intact forest areas, again with a focus on boreal forests. The results from this analysis will then be used for the final objective, which is to find opportunities to use certification for planning of other policy strategies, e.g. aiming at biodiversity conservation, REDD+. Thereby, certification could gain importance not only as a marketing tool for sustainable forest management, but also contribute to international coordination of efforts in other, yet related areas.

METHODOLOGY

Based on the assumptions by Rametsteiner and Simula (2003) with respect to the comparability between the schemes, and also in order to provide a more holistic and independent assessment, we decided to use both the latest FSC (2014) and PEFC (2014) data for forest management certification for the creation of our new mapping tool. Hereby, we intentionally did not distinguish between the different schemes. However, information on the spatial distribution of certified forest is limited and the main players in forest certification report the aggregated results at national level as discussed above. Therefore, in some cases, additional information has been requested from the country organizations. Particularly because of its large country size, special regional information from FSC Russia has been requested with respect to the distribution of certified area by administrative regions (FSC personal communications, 2013). Downscaling of national (regional) certified area statistics has been carried out on the following datasets: (1) a global forest extension mask calibrated with FAO FRA 2010 (Schepaschenko et al. 2013) was used to delineate forest area; (2) the protected areas of IUCN categories I-II have been excluded; and (3) a map of managed forest based on the Global Forest Model G4M (Kindermann et al., 2008), assuming that certification first goes to the most heavily managed area. The downscaling has been performed using a procedure of distribution similar to that used in creating the hybrid cropland map (Fritz et al. 2011, Schepaschenko et al. 2013) based on the above-mentioned input maps. Pixels were selected in the order of highest-managed until the area covered matched that of the forest certification statistics at national scale. For the second objective, we used the map of intact forest (Potapov et al. 2008) to compare intact and certified area. As a rule, the core zones of intact forests are free from any certification. Only Canada has some overlap between intact and certified forest areas.

RESULTS

Clearly, the maps shown in Fig. 1 do not distinguish between unmanaged and managed forest area where it is the latter that is usually certified. This makes it difficult to assess the status-quo and needs of further certification both for the certification bodies themselves as well as for the scientific community. As shown in the literature review, scientists need empirical evidence in the form of detailed statistics in resolutions that are substantially higher than national aggregates.

Fig. 4 represents a substantial improvement in this direction. It uses a more detailed downscaling technique than used by Kraxner et al. (2008), which allows for representation at 1 km resolution, reduced bias through boundary effects and improved national certification distribution over managed forest areas. The most important insight is that Asian Russia, despite having large areas of forest under management, displays the least certification of the boreal countries and especially compared to Canada. The new map enables furthermore, the identification of potential certification hotspots and "low-hanging fruits". Such knowledge makes it possible to analyze strategies to bring those areas under certification, since it also enables to consider the special socio-economic and ecological and institutional conditions prevailing at these very spots. While this is clearly important information for certification schemes and their planning of where and how to deploy their resources, it also conveys valuable input to scientific assessments informing policy makers.

Extending the results presented in Fig. 4, Fig. 5 integrates information on the location of intact forest areas. In order to demonstrate the benefits of our new tool, we picked the Great Lakes Region between Canada and the US. In this specific region, almost all forest in the US is managed. However, certification is scarcely distributed over this area in contrast to Canada. Here we see also most of the forest under management but with almost 100% certification coverage. Most of the intact forest is located in the less productive forest areas of Canada's north. There is almost no intact forest area left on the US side in the Great Lakes area. Protected areas on both sides consist mostly of unmanaged, intact or intact and certified forest. Often, water bodies and intact forests are buffered by certified managed or certified intact forest areas. Policies designed to support certification of managed forest in addition to maintaining forests intact in the first place can thus help more effectively to preserve pristine forests. Clearly, such a strategy comes with a number of co-benefits such as: conserving the biodiversity that is particularly abandoned in intact forests or sequestering carbon by enhancing sustainable forest management. This ties to the 3rd objective of this study and illustrates the vast potential of certification also for the realization of other policy objectives.

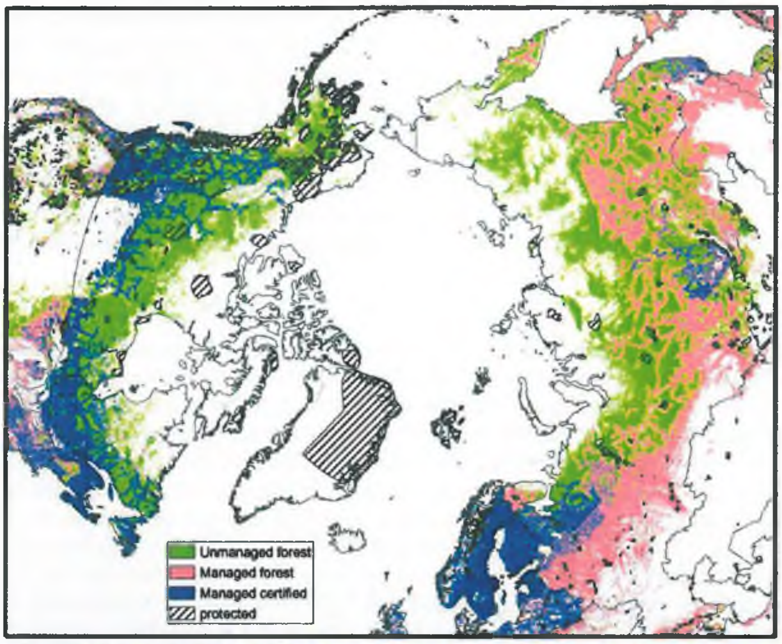

Figure 4: High resolution boreal certification map illustrating boreal forest area and 4 management categories. (White areas are none-forested areas or the sea/water bodies.) Source: own compilation.

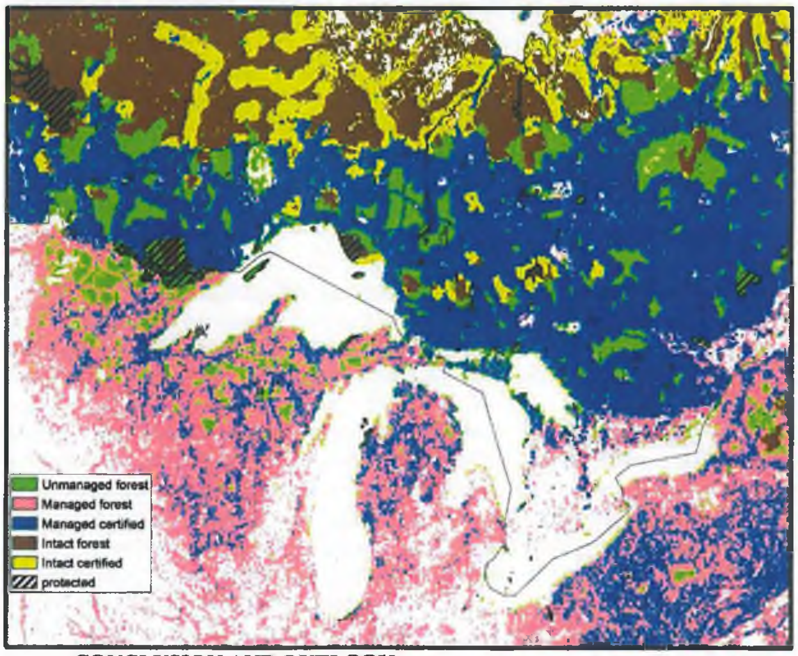

Figure 5: Certification map of the Great Lakes Region between Canada and USA including also intact and intact certified forest area. Note: White area symbolizes the Lakes in the center of the map, whereas it means none-forested land in the south and south-west and further surface water bodies or the sea in the north. Source: own compilation.

CONCLUSION AND OUTLOOK

In this study we have introduced a new tool allowing the localization of certified forest area actively distinguishing between managed and unmanaged forest areas. Having clearly demonstrated the benefits this has for certification itself, it also allows for localization of areas with large co-benefit potential, thereby helping to form targeted policy strategies. The latter could be e.g. fostering sustainable biomass for bioenergy production or REDD+ activities (c.f. Kraxner et al., 2011). This is only possible, if such tools are further developed and applied at the science-policy interface.

It is important to note that the visualization produced with the help of our new tool is of course still contingent on the data available and the assumptions underlying the improved downscaling algorithm. Validation is necessary to further improve these components and move the maps even closer to reality. To achieve this, it is essential that certification schemes and scientists work hand in hand.

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FOREST FIRE RISK AND FIRE RISK CLASSIFICATIONS IN FINLAND

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SUMMARY
Forest fire risk has gradually decreased in Finland. However, large fires in neighboring countries show that preparedness for forest fires is still needed. Decreased forest fire risk is mainly due to changes in legislation, effective fire suppression, building of the forest road network and changes in forest structure associated with intensive forest management. Latest forest fire risk classifications are based on common variables used in forest management: site type, age/development class, tree species and stand structure.

In large parts of Southern Finland slash and burn agriculture and tar burning were common in 18^{th} and 19^{th} century. These resulted in a semi-wild fire regime with many wildfires. The former forest practices, combined with the increased need for industrial timber and a general concern for deforestation, led to the establishment of forest administration and education in 1859 in Finland.

After Finland's 1917 independence, considerable forestry-related research and development was initiated in 1920's and 1930's. At this time scientific and development work was also carried out in forest fire suppression together with practical fire prevention work. Practical handbooks for foresters, fire-fighters and soldiers were available. The military connection in the development work was in many ways significant. During the World War II, the Finnish Army Headquarters wanted to be prepared for possible fire bombing of forests and performed a massive operation together with the Finnish Forest Research Institute in mapping and classifying forests by their fire risk. The result of the work was "Fire Defense Atlas", the first and largest fire risk classification of Finnish Forests. After the war Finnish authorities archived the maps, including maps from areas eventually lost in peace negotiations with Russia, for strategic political reasons. Their existence passed from memory. The maps were rediscovered in 2000, and are now available at National Archives (http://www.arkisto.fi/).

After WWII forest fires and their risks gradually started to decrease due to changes in legislation, effective fire suppression, building of the forest road network and changes in forest structure associated with intensive forest management (Fig. 1). Clear-felling replaced selection felling as the most common felling method and eventually led to even-aged stands. Management with frequent thinning and clear forest compartments in different successional stages, and recently increased harvesting of logging residual for bioenergy have further reduced fire risk. Coincident with the reduced impact of fire on Finnish society there was a decline in scientific interest in fire management, behavior, and to some extent ecology. The main interest in fire research shifted to silvicultural aspects. E.g. the low productivity of raw-humus stands was linked to absence of fire and prescribed burning as general forest regeneration method for old spruce-dominated forests was recommended [3]. This led to an era of prescribed burnings from 1950's to early 1960's until they were replaced by mechanical scarification.

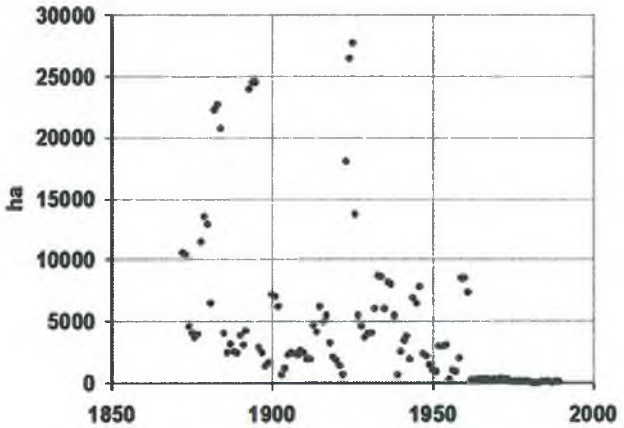

Fig. 1. Annually burned area in state-owned forests in Finland

In Finland, forest fires have not been a major problem in recent decades. Since the 1960's the annually burned area has varied typically between 500 and 1000 hectares, which can be considered as quite low amount, and average area burnt in one fire is currently only 0,4 ha.