WORKSHOP ABSTRACT

Forest Restoration in Abandoned Agricultural Lands in Post-soviet Period: a Comparative Analysis of Two Bordering Regions in Russia and Belarus

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Abstract

After the collapse of the USSR in 1991, the consecutive political crisis and economical transformation caused dramatic changes to the forest-covered areas of the former Soviet republics. Previous research has shown that these changes are mainly due to the natural restoration of forests on the abandoned agricultural lands, but the scale and mechanisms of afforestation are still poorly studied. Furthermore, due to legal regulations regarding the lands' status in some of newly-founded countries, these reforested areas are still counted as agricultural lands, and therefore not a subject of forest-related regulations. Yet, the economic and ecological assessment of the forests covering these areas is essential for understanding of their resource potential, as well as the role in maintaining biodiversity and providing of ecosystem functions and services.

In this work, we combine remote-sensing techniques and ground-based observations to conduct a comprehensive study on the forest restoration processes in two neighboring areas located in the countries with different economical pathways since 1991: western part of Smolensk region, Russia, and eastern part of Vitebsk region, Belarus. We designed our remote-sensing analysis based on the time series of LANDSAT images from 1985–2015. Five-year cloud-free image composites were classified using Random Forest algorithm to four

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classes corresponding to distinct stages of forest restoration in abandoned agricultural lands: arable land, grassland with shrubs, deciduous forest and coniferous forest. Our results demonstrate that in 1985–2015 the afforestation was much more rapid in Russia, where the agricultural area decreased from 74% to 46%, compared to decrease from 70% to 67% in Belarus. In both territories, the intensity of such decrease varied temporally, accelerating in the beginning of 2000s, and the newly restored forests are predominantly deciduous (78% in Russia and 83% in Belarus). We conducted the ground observations in 2016–2017 in the territory of Smolenskoe Poozerye National Park, which also experienced the decline of agricultural lands (from 9.7% of its territory in 1985 to 4.0% in 2015). Based on these data we have shown that the forest restoration succession is determined by the habitat properties, existing mature forest proximity and former land use type. Thus, the dominant species composition of new forests was mainly shaped by soil texture and moisture: the pine stands favored sand soils, birch – dry loams and alders – wet loams.

The results obtained enable to produce scientifically sound forecasts of post-agricultural forests and could be used for decision making support regarding the optimal usage of such reforested agricultural lands – whether it is more reasonable to return them to agricultural use or to start exploiting them in forestry.

WORKSHOP ABSTRACT

Creating Stand Compartments from ALS Grid Data

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Abstract

Forest inventory is increasingly based on airborne laser scanning (ALS). In Finland, the results of these inventories are calculated for small grid cells, 16 m by 16 m in size. As a result, forest planning is no longer constrained by existing stand boundaries, which are often subjectively drawn and obsolete. On the other hand, the use of grid data in forest planning results in the additional requirement for aggregating management prescriptions into large enough continuous treatment units. This aggregation can be done before the planning calculations, using various segmentation techniques, or during the planning calculations, using spatial optimization. Forestry practice usually prefers reasonably permanent segments created before planning. These segments are expected to be homogeneous in terms of site properties, growing stock characteristics, and especially treatments. Recent research has developed methods for aggregating ALS grid data into segments that are homogeneous in terms of site and growing stock characteristics. The current study extended previous methods so that also the similarity of treatments was considered in the segmentation process. The analyses were conducted for two datasets, one from southern and the other from northern Finland. Cellular automaton (CA) was used to aggregate ALS grid cells into segments using site characteristics with (1) growing stock attributes, (2) predicted cutting prescriptions and (3) both stand attributes cutting prescriptions. The CA was optimized for each segmentation task. The results showed that the segmentation was rather similar in all cases, which means that automated stand delineation is not sensitive to the type of variables that are used in the process. The result is not surprising since treatment prescriptions depend on stand attributes. The study also proposed methods to deal with some biases that are likely to appear in the results when grid data are aggregated into segments.

WORKSHOP ABSTRACT

Ecosystem Responses to Long-term Application of Biosolids to a Pine Forest in New Zealand

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Abstract

Biosolids, rich in organic carbon and nutrients, are commonly used as soil amendments on cropland, and preferably on forestland in New Zealand. However, few studies have examined the whole ecosystem responses to application of biosolids on forestland in ecologically based long-term studies. This study investigated the impact on soil and groundwater quality, tree nutrition and growth, and wood quality of long-term biosolids application to a radiata pine plantation forest growing on a poor soil at Rabbit Island in Nelson, New Zealand. Biosolids have been applied to the trial site every three years from 1997 to 2012 at three application rates: 0 (Control), 300 (Standard) and 600 (High) kg·N·ha^{-1}. Tree nutrition and growth were monitored annually, soil properties every three years, and groundwater quality quarterly. Both the Standard and High biosolids treatments significantly increased soil total C, N and P, Olsen P, and reduced soil pH at 0–50 cm, and increased soil total N at 50–75 cm. The High biosolids treatment also increased concentrations of soil total Cr at 0–25 cm, and Zn at 25–50 cm, but they were considered very low for a soil. Ecotoxicological assessment showed no significant adverse effects of biosolids application on springtails reproduction and soil microbial biomass. Biosolids application significantly increased foliar N concentration and tree stem volume growth. Wood density was slightly reduced by biosolids application. The electrical conductivity and the concentrations of Cu, Cr and Zn of groundwater appeared to increase slightly over the

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period of biosolids application. We concluded that long-term application of biosolids to a plantation forest on a poor site could significantly improve soil fertility, tree nutrition and site productivity without causing significant adverse impact on the receiving environment. Beneficial use of biosolids on marginal land was an effective means of increasing carbon sequestration in the pine forest and sandy soil. However, the long-term fate of biosolids-derived heavy metals and organic pollutants in the receiving environment needs to be further monitored.

Keywords: Biosolids forestland application, Growth and nutritional responses, Soil quality and health, Groundwater quality

WORKSHOP ABSTRACT

Hybridization in *Pinus* and its Implications in Forest Management

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Abstract

Hybridization is fairly common in natural plant populations. It plays a key role in evolution, from shared traits between species to hybrid speciation. Although hybrids are often unfit in relation to their ancestors because of reproductive barriers, reduced vigor or low adaptation to the environment, in other cases their higher genetic diversity increases evolutionary and ecological resilience and phenotypic traits. As in many other groups, genetic exchange is occurring or has long occurred among pine species. The genus *Pinus* includes about 120 species of boreal distribution. Most studies on hybrids center on evolutionary aspects, but others analyze the levels of fitness relative to the parental taxa. Here, we review the knowledge on hybridization among pine species with a focus on the resulting advantages and disadvantages related to adaptation, hardiness, and desirable traits in timber trees. As for recent hybrids and individuals in ongoing processes of introgression (F1 and back-cross individuals), fitness can be lower or higher than that of the parents with regard to vegetative and reproductive traits (e.g., vigor, straightness of the trunk, seed and seedling viability, growth rates), hardiness (drought, heath or cold-tolerance), capability to adapt rapidly to environmental changes, or resistance to disease. But cases of better fitness than the parents can be found in recent hybrids as well as in nothospecies of ancient origin. An example of the later is *Pinus densata*, which has better

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seedling characteristics, higher viability, faster growth rates, and enhanced drought-tolerance than its parents. Hybrids in pines are presented in a checklist including their putative parents, main resulting traits and sources of information. Very likely many additional hybrids still not recorded occur in the genus. However, despite the increasing amount of evidence about their commonness, hybrids and introgressed individuals are usually not considered in forestry policies. At least in some countries, combined names indicating hybridization or introgression are in fact not allowed in paperwork and in inventory and monitoring forms, where species names shall be recorded as representing "pure" biological entities. A shift of paradigm is urgently needed to adjust forestry policies, management, and breeding programs to the real situation in which genetically mixed biological entities are common in forest ecosystems.

WORKSHOP ABSTRACT

Survival Strategy of the Light-demanding Korean Pine under Dense Deciduous Forest

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Abstract

Korean pine (*Pinus koraiensis*) is widely distributed in northeast China and the Fareast Russia, which is a construction species in the climax vegetation. However, the maintenance of Korean pine population has long been a mystery; the regeneration under the pioneer secondary forest is continuous in age construction but no saplings in the Korean pine-dominated primary forest can be found. Although seedlings in the primary forest are tremendous but few individuals can transit to saplings, not to mention to adult trees. The secondary forest dominated by birch (*Betula platyphylla*) and aspen (*Populus davidiana*) are the pioneer stage of succession after stand replacement of disturbance, *eg*. wind fall and fires, on the primary forest. It is generally believed that the floor of deciduous forest has a good condition in terms of light availability, but in fact it is even darker than in the primary forest during the vigorous growing season.

This study investigated seasonal understory light availability in addition to C gain of Korean pine in the primary and secondary stages, the storage of nonstructural carbohydrate (NSC) in seedlings, and the growth and survival of seedlings under manipulated light regimes.

Understory light intensities in early spring and late autumn in the secondary forest were significantly higher than that in the primary forest. The main C gain of understory Korean pine was in early spring and late autumn periods, and in the growing season (summer) it was negative. In both early spring and late autumn, C gain in the secondary forest was significantly higher than that in the primary forest.

The total NSC concentrations of understory Korean pine saplings showed an increasing trend in

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non-growing season, versus a decreasing trend in growing season. In particular, the dominant compound was starch in early spring, while in autumn it was replaced by soluble sugar.

Based on simulated experiment, the biomass, NSC concentration and pool sizes, as well as survival rate all showed positive correlation with light availability, revealing that the species is light demanding or shade intolerant. The accumulated survival rate, examined in the autumn, was less correlated with biomass, but positively with carbohydrate storage in autumn.

High light availability and positive C gain in early spring and late autumn are key factors affecting the growth and survival of understory seedlings. These two periods in the secondary forest are crucial for the survival of seedlings by securing sufficient energy to pass through the dark summer period. In the primary forest, by contrast, the light availability presented relatively stable across all seasons, especially in the leaf-off period, and insufficient through-canopy radiation, plus dense lateral closure, made the seedlings withered before transiting to saplings.

Keywords: Regeneration, Nonstructural carbohydrate, Survival strategy, Carbon gain, Non-growing season

WORKSHOP ABSTRACT

Forest Diversification as a Solution to Counteract Climate Change Effects on Oak and Beech?

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Abstract

Forests are extremely vulnerable to climate change due to the sessile character and slow adaptation of trees, potentially jeopardizing numerous functions and ecosystem services. Complex, mixed forest stands might be less fragile than monospecific stands but a lack of knowledge and technical expertise hindered the widespread adoption of this adaptation measure so far. Recently, a vast body of research has examined climate change effects on tree performance and the potential mitigation by higher tree species diversity in Belgium. The goal of this paper is to synthesize and contextualize this research in order to reveal both risks for forests related with climate change and solutions to obtain more resilient forests.

First, we looked at climate projections for North West Europe in general and Belgium more specifically. Second, we reviewed Western European literature on the effects of water availability and temperature on physiology, growth and mortality of trees, and the potential interaction with tree species diversity. We focused on oak and beech, two common deciduous tree species in temperate Europe with high economic and ecological importance, and distinguished between different life stages.

Projections for central Europe indicated a warming of 2–5°C by 2100 and the results for Belgium were similar. Central European winter precipitation is expected to increase with 5–10%, while summer precipitation balances between 2% increase and 7% decrease. For Belgium, models predicted significant increases in winter precipitation and significant decreases in summer precipitation. Literature indicated an overall negative effect of lower water availability

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on growth and physiology of oak and beech seedlings, saplings and mature trees, while the influence of temperature was more variable. Tree species diversity showed an inconsistent effect on oak growth, but it mitigated the negative response of oak growth to drought. Contrastingly, diverse forest stands had a higher beech growth and survival, although it did not affect the response of beech growth in dry years.

We conclude that especially lower summer precipitation poses a threat to the survival and growth of beech and oak. Increasing tree species diversity may improve the performance of trees depending on their species-specific ecology, although this is not intrinsically linked with a higher resilience to climate change.

WORKSHOP ABSTRACT

Forestry Remote Sensing from Unmanned Aerial Vehicles: a Review Focusing on the Data, Processing and Potentialities

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Abstract

Currently, climate change poses a global threat, which may compromise the sustainability of agriculture, forestry and other land surface system. In a changing world scenario, the economic importance of Remote Sensing (RS) to monitor forests and agricultural resources is imperative towards to the development of agroforestry-systems, services and products that serve the user purposes. RS provides several techniques that are able to measure different Earth physical properties using reflected or emitted energy, at a given time or period. Traditional RS technologies encompass satellite and manned aircraft platforms. These platforms are continuously improving in terms of spatial, spectral, and temporal resolutions. At its current stage, RS has been strongly influenced by the significant progress in several technologies, such as advanced data processing techniques, Geographical Information Systems and Global Navigation Satellite Systems, which contributed to improve and expand RS for forestry applications.

The high spatial and temporal resolutions, flexibility and much lower operational costs make Unmanned Aerial Vehicles (UAVs) a good alternative to traditional RS platforms for forestry applications. In the management process of forests resources, UAV is one of the most suitable options to consider, mostly due to: (1) low material and operational costs and high-intensity data collection; (2) its capacity to host a wide range of sensors that could be adapted to be task-oriented; (3) its ability to plan data acquisition campaigns in a flexible manner, avoiding

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inadequate weather conditions and providing data availability on-demand and; (4) the possibility to be used in real-time operations, for example, using thermal sensors that could be operate in order to detect forest fires, contributing to control fire spread in space and time.

This paper aims to present the most significant UAV applications in forestry, identifying the appropriate sensors to be used in each situation as well as the data processing techniques commonly implemented. Considering the advantages identified, many studies performed focusing in forestry applications clearly reflect the opportunities that have emerged with the appearance of UAVs. Moreover, the high costs of high-resolution satellite remote sensing data and problems related with frequent cloud cover, together with UAVs' flexibility and operability also contributed to promote it use in forestry.

The use of professional civilian UAS is increasing rapidly around the world, and it is expected to explode in the upcoming years.

WORKSHOP ABSTRACT

The Northeast Asian Temperate Mixed Broadleaved-conifer Forests Face the Profound Transformation in the Nearest Future: Results from Retrospective and Prognostic Niche Modeling

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Abstract

Retrospective and predictive modeling of the bioclimatic niches of Korean pine, the main forest-forming species of mixed deciduous and coniferous forests of East Asia showed that the most important bioclimatic parameters controlling the geographical distribution of Korean pine are the amount of precipitation in the form of rain, the Kira's warmth and coldness indices and the continentality index. Retrospective models showed that in conditions of LGM, the Korean pine bioclimatic refugia could persist in the Changbai region, in the mountainous conditions of the Korean Peninsula and covered the northern part of Honshu Island that was confirmed by macro and microfossils. Current trends in climate change will lead to a significant shift in the range of Korean pine towards the north and to the areas with oceanic climate. The most ancient populations of the species are expected to be lost on the territory of the Korean Peninsula and Honshu Island.

WORKSHOP ABSTRACT

Forest-level Optimization Using a Differentiable Model

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Abstract

We present a model for forest harvest scheduling that differs from the typical approach of, first, simulating alternative management prescriptions for the calculation units and, secondly, use combinatorial optimization to seek the combination of alternatives that maximizes the objective function while satisfying the possible constraints. Specifically, our approach uses continuous functions, which have continuous derivatives in almost all points, to model the harvest scheduling task as a linearly constrained smooth multi-objective optimization problem. It avoids the simulation of a discrete number of alternatives for managing each stand and can be efficiently solved by a derivative-based optimization method. We analyze the model considering two objectives: maximize soil expectation value and even-flow of volume harvested in an {\it Eucalyptus globulus} Labill. forest of Galicia (NW Spain). Finally, we briefly give some interesting conclusions.

WORKSHOP ABSTRACT

Long-term Ecological Research; Insights into Dry Forest Dynamics at Peninsular India

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Abstract

Long-term ecological research is necessary for understanding the processes that drive the diversity and dynamics of a forest. There is a growing thrust for the need to establish permanent plots for long-term observations. Center for Tropical Forest Science (CTFS) is one such consortium of researchers across the globe with a mandate to study both tropical and temperate forests. Data gathered in a uniform method would allow cross-plot comparisons that would enhance the understanding of plant responses to different environmental conditions. Mudumalai is one of the plots in this consortium.

The dry forest of Mudumalai is located in the Nilgiri Biosphere Reserve (NBR), the first biosphere reserve to be established in India. The mandate of research is to understand mechanisms that drive the tropical diversity and to understand the drivers of forest dynamics. Mudumalai is subjected to annual dry season ground fire and has one of the high densities of large herbivores. Mudumalai is also characterized by variability in annual rainfall. All these factors have strong influence on the dynamics and resilience of the forest. Hence it becomes interesting in the face of environmental stochasticity to understand the ecology of the dry forests that forms one of the large vegetation types in India.

The results presented is from the large 50 ha permanent vegetation plot established in the year 1988–1989. All woody individuals > 1 cm dbh are identified, measured for size, given a unique number and mapped for spatial locations. Since then plot is being monitored for recuritment and mortality annually and sizes of all living stems are measured once in four years

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for growth. We report the pattern observed till 2015. Total population of the plot has shown considerable fluctuation across years and currently it has crossed the initial population of 26,000. There is a considerable turnover in lower sized individuals while there was stability among the higher size class. Mean mortalilty rate was 0.08 ± 0.065 (range 0.004–0.243, *N* = 27). Mean recruitment rate in the plot was 0.106 ± 0.12 (range 0.008–0.478, *N* = 27). The basal area of the plot has shown increasing trend. Similar trend was also observed with biomass. With all the different stress that these forests are experiencing, there is still sequestration of carbon is taking place.

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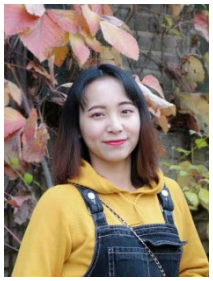

Thermal and Water Effects on Ectmycorrhizal Fungi Foraging in *Abies fraxoniana*

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Abstract

Climate change has had a significant impact on the growth and migration pattern of *Abies faxoniana*, a native fir species widely distributed in southwest China, which survived previous adverse environmental conditions. The mechanism of climate change on the survival and development of this species is worth exploring. Mycorrhizal symbioses are widespread and common in terrestrial ecosystems around the World. These symbiotic fungi are often crucial for the uptake or mobilization of nutrients (e.g. NPK) by secreting related enzymes and water from the soil and transferring them to plants. This is an important nutrient uptake mechanism for the plants. To evaluate the effects of climatic factors on ectomycorrhizal foraging strategies of *Abies faxoniana*, we compared the ectomycorrhizal symbioses traits in three core distribution areas (Wolong Nature Reserve, Miyaluo Nature Reserve and Wanglang Nature Reserve) as well as at five altitudinal levels (2850, 3000, 3194, 3413, 3594 m *asl.*) in the Wolong Nature Reserve. We collected root and soil samples using the Point-Centered Quarter Method. The statistical analysis was performed by using principal component analysis, redundancy analysis and curve estimation modeling. We found that the variation pattern of ectomycorrhizal foraging along with altitudes, mean annual temperature and mean annual rainfall were important factors that impact on the foraging scale, foraging precision and plasticity of ectomycorrhzae in *Abies faxoniana*. The morphological diversity of the *Abies faxoniana* ectomycorrhizae decreased with increasing elevation. Root tips of contact exploration types increased, whereas the root tips of medium distance exploration types decreased with increasing elevation. We found significant positive relationships between ectomycorrhizal morphological diversity, root tips of the medium distance exploration type

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and soil temperature ($P < 0.05$). Significant negative relationships were found between root tips of the contact exploration types and soil temperature ($P < 0.05$). Mean annual temperature and mean annual rainfall had the greatest influence on ectomycorrhizal root tips, morphological diversity and short distance exploration types.

Our study suggests that the ectomycorrhizal foraging strategies of *Abies faxoniana* at lower altitudes are characterized by more root biomass accumulation and greater morphological differentiation. At higher altitudes the strategy is characterized by higher absorption efficiency, greater foraging scale and less morphological differentiation. In addition to these altitudinal effects, the mean annual temperature and mean annual rainfall were the key factors affecting the ectomycorrhizal root formation and morphological differentiation of *Abies faxoniana*.

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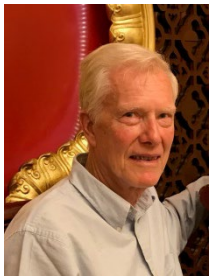

Using SAD's, SAR's and CDM's for Characterizing the Biological Features of Forest Communities

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Data provided by: Jalil Alavi, Juan-Gabriel Álvarez González, Juan Rommel Baluarte-Vásquez, Mykola Korol, Javier Corral Rivas, Rajesh Kumar, JingJing Liang, Peter Meyer, O.K. Remadevi, Chunyu Zhang, XiuHai Zhao, Yan Yan and South African National Parks

Abstract

Much detail about a forest community can be assessed remotely, and sometimes with higher precision than that obtained in a standard field cruise. However, despite numerous attempts, remote identification of tree species is a distant prospect. This is one of the reasons why permanent ground plots are still being established in many regions of the world. We briefly review old and new networks of forest plots, including global and national assessments, and present some results relating to the biological features of 33 forest communities with mapped trees in Asia, Europe, Africa and America. We discuss species **abundance distributions** (SAD's), **species-area relations** (SAR's) and **community dissimilarity metrics** (CDM's) for the different forest communities. Permanent field plots with mapped trees, identified by qualified taxonomists, represent a national "green" infrastructure that provides an essential scientific basis in a time of rapid change.

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