WORKSHOP ABSTRACT

Exploring the Factors Affecting Carbon and Nutrient Concentrations in Biomass Components of Forest Plantations and Short Rotation Forestry

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Abstract

Coupling biomass models with nutrient concentrations can provide sound estimations of carbon and nutrient contents, enabling the improvement of carbon and nutrient balance in forest ecosystems. Nutrient concentrations can be considered constant for some species and specific tree components, provided that stands are mature. But in most cases the concentrations should be considered variable, being the main sources of variation the tree species, genetic material, tree component, tree age and site index. In this study we review the information gathered for a number of tree species in southwestern Europe, including both native and exotic species managed in a range of rotation lengths. Data for *Populus* x *canadensis*, *Populus* x *interamericana*, *Eucalyptus globulus*, *Eucalyptus nitens*, *Pinus pinaster*, *Pinus radiata* and *Quercus robur* is shown. Some techniques to rank the contribution of the sources of variation of nutrient concentrations, mainly boosted regression trees and conventional techniques, are presented and applied to data bases. The results show the following factors as the main sources of variation: species > biomass fraction >> site index > age ≈ tree biomass > genetics ≈ social class. The concentrations of Ca, Mg, K and P were more strongly affected by site index, age and genetics. The concentrations of nutrients in several of the biomass components varied with age and either increased (e.g. C) or decreased (e.g. P, Ca). Use of the selected clones can provide biomass at a relatively lower nutrient cost.

WORKSHOP ABSTRACT

Mapping Tree Canopies in Urban Environments Using Airborne Laser Scanning (ALS): A Vancouver Case Study

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Abstract

Background: The distribution of forest vegetation within urban environments is critically important as it influences urban environmental conditions and the energy exchange through the absorption of solar radiation and modulation of evapotranspiration. It also plays an important role filtering urban water systems and reducing storm water runoff. Conventionally, information about urban forest canopy and species composition is obtained from field sampling, manual interpretation of aerial photography and, more recently, using technologies such as Google Street View. Remote sensing offers a unique approach for mapping urban forests with Airborne laser scanning (ALS) which directly measures the three-dimensional structure of vegetation. We investigate the capacity of ALS data to individually detect, map and characterize large (taller than 15 m) trees within the City of Vancouver. Large trees are critical for the function and character of Vancouver's urban forest. We used an object-based approach for individual tree detection and segmentation designed to both locate tree locations (position of the stem) and to delineate the shape of the crowns.

Results: Results indicate a detection rate of 76.6% for trees > 15 m with an error and bias equal to 2.60 m and −1.87 m. Missed trees are principally a result of undetected treetops occurring in dense, overlapping canopies with more accurate detection and delineation of trees in open areas.

Conclusion: By identifying key structural trees across Vancouver's urban forests, we can better understand their role in providing ecosystem goods and services for city residents.

WORKSHOP ABSTRACT

Effect of Thinning Intensity on the Growth Pattern of Main Tree Species in Broad-leaved Korean pine Forests

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Abstract

Based on the survey data of 3 fixed plots with thinning intensities of 15% (low), 30% (moderate), and 50% (severe) in the broad-leaved Korean pine forests of Jiaohe in Jilin in 2011 and 2017, the analysis of different thinnings the growth characteristics of *Pinus koraiensis* and *Fraxinus mandshurica* under intensities were investigated. The response to the thinning intensities of *Pinus koraiensis* and *Fraxinus mandshurica* under different conditions of changes in the competitive environment and varying degrees of change were investigated. The results showed that there were significant differences in the growth of *Fraxinus mandshurica* and *Pinus koraiensis* under different thinning intensities. The growth of *Fraxinus mandshurica* was significantly higher than that of *Pinus koraiensis* ($p < 0.001$), and the difference was more pronounced with the increase in the thinning intensity(BAI 轻度差值 = 5.41 cm^2/ha, BAI 重度差值 = 40.1 cm^2/ha); Thinning intensity had a lagging effect on the growth of Korean pine and *Fraxinus mandshurica*, except that the growth of *Pinus koraiensis* under mild and severe thinning showed a transient increase. Beyond the trend, both *Pinus koraiensis* and *Fraxinus mandshurica* showed rapid growth in the fifth year in each thinning intensity. In each cutting site, only the competition and environmental changes (improved by thinning) occurred in the growth and release of Korean pine and *Fraxinus mandshurica*, but the competition did not significantly promote the growth of *Fraxinus mandshurica*, the growth of *Fraxinus mandshurica*, which was not affected by thinning, was always higher than that of the thinning wood. The impact of competition changes on the promotion of *Pinus koraiensis* is only seen in the fifth year under the influence of mild and severe thinning.

WORKSHOP ABSTRACT

Long-term Experiments in Forests. Essential for Facts on Stand Dynamics and Evidence of Human Influence

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Abstract

Long-term experimental plots provide knowledge of forest stand dynamics which can not be derived by forest inventories or any other temporary plots.

First, the most unique features and facts of long-term experiments are presented. As they mostly comprise unthinned plots, long-term experiments represent the site specific maximum density. By measuring the remaining as well as the removal stand, long-term experiments provide the total yield at a given site which is most relevant for the site quality-productivity relationship, the assessment of the carbon sink and the scheduling of intermediate harvest. If they cover a whole rotation period or even the previous and succeeding stand growth at a given site they can reveal the species-specific long-term behaviour and any growth trends caused by environmental changes.

Second, the unique data of central European long-term experiments, with some of them under survey since 1870, will be exploited for answering some present-day questions. It is shown that tree species mixing can increase stand productivity, that growth rates accelerated but wood density decreased since 1870. Long-term consequences of cultivating specific species provenances and applying various silvicultural treatments are presented. Forest science would be unable to get such findings without long-term experiments.

Third, the relevance of these findings for forest science and practice is discussed. Long-term experiments promote forest modelling and theory building. They support the development and training of silvicultural guidelines.

WORKSHOP ABSTRACT

Beyond Island Biogeography Theory: Lessons from Indian Archipelagos

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Abstract

In this paper we provide two sets of data from two different systems of islands in India to illustrate the possibilities of deriving new insights beyond the primary prediction of the Island Biogeography (IB) theory.

First, we provide a test of the prediction of the Island Biogeography theory on Specie Area relations using tree communities of Andaman and Nicobar (AN) islands and show that the power function of the relation is much higher than that expected for trees. We propose that this is because the vegetation of the AN archipelago is composed of two distinct bio-geographic regions viz., of Indo-Burma-China in the north and of Java-Sumatra in the south. To test this, we mapped the species composition of the islands at a very fine scale (10 sq km grids) and analyzed the phylogenetic affiliation among the vegetation of these grids. Results showed that the AN islands harbor phylogenetically three distinct spatially isolated clusters of vegetation: while the northern Andaman group of islands, proximal to Myanmar, harbor one type of tree community, the southern Nicobar islands, near to Java and Indonesian islands harbor a second type; the mid part appears to be a confluence of the two phyloclusters. A combined analysis of tree communities from these distinct phyloclusters results in a much steeper raise in species richness with the island size. Thus we show that the primary prediction of IB theory is likely to be affected by the differential sources of vegetation.

Second, by exploring all possible sets of species assemblages on islands of different sizes, we derive the prediction that the similarity among islands for their species composition decreases with their size. We tested this prediction using tree species composition of the Shola forests–the naturally fragmented forest patches amid grasslands along the Western Ghats. Based on our results we show that there are patterns beyond the primary prediction of the Island Biogeography theory that offer different lessons for conservation.

WORKSHOP ABSTRACT

Growth at the Microscale: Stem Increment and Wood Property Responses in *Pinus radiata* Under Varied Thinning Regimes

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Abstract

Stem radial growth in in forests is not uniform. Rather, it is characterized by periods of relatively fast or slow growth, or sometimes no growth at all. These fluctuations are generally a function of varying environmental conditions (e.g. water availability) and, importantly, will also be associated with adjustments in properties in the wood formed. Patterns of growth and wood property variation will, however, also be influenced by stand level conditions and forest management, particularly thinning and stand density. We propose that differences in overall growth between, for example, stands at two planting densities, can largely be attributed to an interplay of three developmental dynamics: (i) growing season duration, (ii) days of increment within the season (iii) short-term rates of growth on "growth days". In this paper, we explore how different thinning histories and/or stand densities influence the dynamics of tree growth, and associated wood property variation, in the important commercial plantation species *Pinus radiata*. At two Australian case study sites (Flynn and Mt Gambier) at which different thinning regimes were applied, we installed a set of high precision electronic point dendrometers on selected trees, and monitored sub-daily radial stem size change over two growing seasons. We also took wood core and periodic cambial samples, which were analysed in detail microscopically and using x-ray densitometry.

Our results showed that greater overall cross-sectional growth in thinned trees (in both, although very different, cases) was driven mainly by two dynamics. First, the cessation of seasonal growth occurred later when trees had been thinned. There was no difference, however, in the timing of growth onset. Second, trees which had been thinned grew on more days, within the season, than unthinned trees. Interestingly, the rates of growth on days when particular (Flynn; where final stand densities were very different), we noted a relative growth occurred in

WORKSHOP ABSTRACT

both cases, were not different. In this context, at one of our sites in "non-responsiveness" in thinned trees as compared to unthinned trees, and that they they did not exhibit pulses of growth in the same way. It was notable, however, that unthinned trees also maintained a smaller, but apparently consistent, cambial zone throughout the season than thinned trees. At both sites and at all treatments, there was a clear band of earlywood formed, in which wood density and tracheid diameter remained constant until a distinct change occurred after about 2.5 months of growth. Only in the unthinned, high density (975 S/ha) trees at Flynn was there any indication of the switch from earlywood occurring earlier than September (Southern Hemisphere Spring). There was some indication of lower density wood forming (at the ring level) in the thinned trees in our study.

We discuss the role of competition between trees in interpreting our findings, and the significance of these data for ongoing development and testing of precision modelling approaches in *P. radiata*.

WORKSHOP ABSTRACT

The Nomination of Hyrcanian Old-growth Forests for Inscription to UNESCO World Heritage: Implications for Nature Conservation

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Abstract

Hyrcanian forests belong to 25–40 million years ago as one of old growth forest ecosystem of the world which covers an area of 1.9 million hectares. It has high growth capacity due to humid temperate climate and fertile soil. Diverse ecological situation such as wide longitudinal range with length of 850 km, Altitudinal diversity from − 25 to 5671 m asl, different annual rainfall between 700–2000 mm, High geological diversity and five different Macro - Climate Units made Hyrcanian area as an unique forest ecosystem. More than 3,000 vascular plants have been documented in the forests and immediately adjacent ecosystems. It includes some valuable alive fossil species and refuge of Arcto-Tertiary elements such as *Populus caspica*, *Gleditsia caspica*, *Parrotia persica*, *Zelkova carpinifolia* and *Pterocaria fraxinifolia*. The longstanding, isolated evolution of the Hyrcanian Forests has resulted in a high degree of relic and endemic species across many taxonomic groups. The conservation of this valuable ecosystem and heritage of humankind is a must. The rationale for the World Heritage Convention is: they are part of a heritage of all humankind, their protection is our shared responsibility and they are held in trust for this and future generations. Inscription on the World Heritage List is proposed under Criterion (ix): The nominated area is a globally outstanding example of the evolution of temperate forests, the survival of fossil tree species, as well as of the ongoing ecological processes of diversification and adaptation to constantly changing environmental conditions. The scale and the degree of naturalness are extraordinary by the standards of temperate forests, which is why natural ecological and biological processes continue to function in ways that are not possible elsewhere and Criterion (x): The nominated area is the natural habitat for numerous relic, rare, endangered, and endemic species, for which the Hyrcanian Forests are renowned. The nomination represents one important stepping stone in the identification and long-term protection of a representative network of the most valuable forests areas. There is room for further refining the available information and to further develop the network of protected areas in the Hyrcanian Forest.

WORKSHOP ABSTRACT

The Southern United States

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Abstract

The southern United States has been managed extensively by humans since the onset of European colonization in the 1600s. This study examines the current use of the southern landscape as was observable through high-resolution, low altitude aerial images available in Google Earth. Image interpretation principles were applied to 15,000 random point locations throughout the south, covering the imagery available over a seven year time period (2007–2013), to determine the proportion of area devoted to thirteen major land use classes. The estimated total amount of forested area was 42.6% on average, yet declined about 0.35% over the time period. Where losses in forest area were observable after final harvests, land transitioned to agricultural land, pasture, grass (yards), and other low intense uses of land. The average amount of natural coniferous, deciduous, and mixed forests, pine plantations, and cypress forests was estimated to be 3.5%, 17.8%, 12.0%, 8.6%, and 0.6%, respectively, of the entire southern landscape. The level of final harvest activity averaged 0.5% per year in deciduous forests, 1.35% per year in natural coniferous forests, and 1.84% per year in pine plantations. The level of thinning activity in pine plantations averaged 3.66% per year, with an average of five years between a thinning and a final harvest. Increases were observed in developmental activities (houses, buildings, etc.) and in the expansion of transportation systems (roads). Pine plantation area increased slightly throughout the seven-year time period, from 8.43% to 8.72%. Developed areas (homes, businesses, etc.) increased from 1.31% to 1.46% of the south over the study period, while grass areas (including natural grassy areas, yards around houses, and lawns around businesses) increased from 5.93% to 6.42%, and transportation (roads, railroads) increased from 1.54% to 1.61% of the south. These increases in the human living and commerce space of the southern landscape came at the expense of forested ecosystems, cropland, and pasture areas.

WORKSHOP ABSTRACT

The National Forest Inventory in India

Developments and New Design

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Abstract

India, unlike most other countries which are located between the tropics of cancer and capricorn, can look back on a long history of professional forest assessment. This study presents details of the history and recent developments of the National Forest Inventory of India. The idea that continuous forest observation was necessary for scientific and sustainable forest use gained momentum especially after the Third Silvicultural Conference which had convened in Dehradun in 1929. Details of those early plots are presented, and developments towards a National Forest Inventory are recorded, beginning with the Pre-Investment Survey of Forest Resources (1965–1980); the initial activities of the Forest Survey of India (1981–2002) and the gradual adaptation to increasing information requirements (2002–2017). Pilot studies were conducted between 2010 and 2014 in Karnataka, Rajasthan, Assam and Himachal Pradesh by the Indian Council for Forest Research and Education to evaluate new developments in permanent observational plot design and analysis. Based on these studies and the increasing need for permanent observation, several workshops were conducted in 2017 to explore new approaches of combining temporary sampling and permanent observation. Based on this preparatory work, our study presents a new integrated design with a focus on terrestrial assessments using a mix of temporary and permanent field plots. The new design which addresses the need for permanent monitoring, includes new technical developments, and takes account of the unique conditions in India, may serve as an example for other regions with similar socio-ecological requirement.

WORKSHOP ABSTRACT

Predicting the Provisioning Potential of Forest Ecosystem Services Using Airborne Laser Scanning Data and Forest Resource Maps

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Abstract

Background: Remote sensing-based mapping of the supply, potential, demand and stock of forest Ecosystem Services (ESs) has become increasingly popular. The resulting maps may enable to spatially assess the provisioning potential of ESs and prioritize the land use in subsequent decision analyses. However, the mapping is often based on readily available data, such as land cover maps and other publicly available databases, and ignoring the related uncertainties. This study tested the potential to improve the robustness of the decisions by means of local model fitting and uncertainty analysis.

Results: Prediction models based on Airborne Laser Scanning (ALS) data explained the variation in proxies of the suitability of forest plots for maintaining biodiversity, producing timber, storing carbon, or providing recreational uses (berry picking and visual amenity) with RMSEs of 15%–30%, depending on the ES. The RMSEs of the ALS-based predictions were 47%–97% of those derived from forest resource maps with a similar resolution. Due to applying a similar field calibration step on both of the data sources, the difference can be attributed to the better ability of ALS to explain the variation in the ES proxies. The quality of land use prioritization based on the obtained information showed differences, when evaluated under two different decision support models: either using the developed models deterministically or in corporation with the uncertainties of the models.

Conclusions: Despite the different accuracies, proxy values predicted by both the data sources could be used for a pixel-based prioritization of land use at a resolution of 250 m^2, i.e., in a considerably more detailed scale than required by current operational forest management. The uncertainty analysis indicated that maps of the ES provisioning potential should be prepared separately based on expected and extreme outcomes of the ES proxy models to fully describe the production possibilities of the landscape under the uncertainties in the models.

Forestry in the Anthropocene: a Novel Functional and Multi-scale Forest Management Approach for Our Cultivated Planet

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Abstract

We have entered a new geological era, the Anthropocene, where unexpected, extreme disturbance events as well as rapid socio-economical changes are affecting the resilience of our forests and consequently the provision of many important forest ecosystem services. This new era means that we need to develop novel forest management approaches that are more flexible and better at dealing with this increasing uncertainty brought about by accelerating global change factors. I will quickly review past and current forest management such as practices in Europe and North-America and evaluate their potential impacts in achieving multi-functionality in the face of increasingly uncertain future. I will then see what novel forest management practices are being tried and proposed that can help us achieve our objectives of managing for multi-functionality under increasingly uncertain future environmental conditions. Such novel approaches as managing forest based on complex adaptive systems, implementing assisted migration, multi-species plantations, sustainable intensification of forestry and managing for resilience will be presented. This short review of past, current and novel forest management practices will set the stage for a proposed new integrated and multi-functionality approach that reconciles previous and novel proposed forestry practices to achieve our new objective of multi-functionality under increasingly uncertain environmental conditions brought about by global change factors. The approach makes use of the latest ecological scientific information available regarding functional traits, complementarity, complex adaptive system and network theory as well as global change predictions at regional scales. It relies on the quantification and dynamic monitoring of two functional (functional diversity and redundancy in tree species) and three spatial (connectivity, centrality and modularity) indices calculated at various spatial scales to determine which forest management practices, old or new, could be implemented and where to maximise the adaptive capacity and resilience of the forest landscape to global change factors at the lowest cost. An example of how such an approach could be implemented in a fragmented forest landscape of Eastern North America will be presented.

WORKSHOP ABSTRACT

An Analysis of the Nested Plot Design

for Monitoring Forest Ecosystems

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Abstract

A popular design of forest sampling is the nested circular plot which is used in several National Forest Inventories, e.g. USA, Russia and some European countries. Trees are segregated by specific diameter classes, and the corresponding plot sizes are bigger for trees that contribute more to total volume. Inclusion probabilities are thus linked to tree size; each tree representing a per hectare value based on the inverse of its plot area. However, understanding the link between the biosphere and other Earth system components has created a demand for target variables in addition to volume. Forest structure and diversity has a profound effect on how ecosystems function, how carbon, water and nutrients are cycled and thus on the provision of ecosystem services. This study uses observations from two large field plots and several simulated forests with varying numbers of species. "Nested" and "Full" plot distributions of basal area, number of trees, species richness, diameter coefficient of variation and plot spatial structure are compared. The results confirm the efficiency of the nested design for estimating timber volume. However, estimates of species richness, and other structural attributes differ between the "Nested" and "Full" design, especially in species-rich ecosystems. The magnitude of the differences is affected by the radii of the nested plot, the diameter threshold, and the number of small-sized species in the bigger subplot. Considering the importance of the nested design in forest inventories, these first results provide sufficient reason for an in-depth study of the nested design involving a broad range of target variables that are relevant for the provision of ecosystem services.