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Forest Ecosystem Services for Biodiversity and Bioeconomy

An Interdisciplinary Workshop
September 14-20, 2015
Beijing, P.R. China

Beijing Forestry University

West Virginia University

Acknowledgements

The Organizing Committee thanks our host:

Beijing Forestry University

Dr. Weiming Song, President

Dr. Xiuhai Zhao, Professor of Ecology

Dr. Klaus v. Gadow, Editor-in-chief, *Forest Ecosystems*

Dr. Hui Li, Editor of *Forest Ecosystems*

for their hard work and support to the workshop.

The Organizing Committee also gratefully acknowledges all the invited speakers for their times and willingness to share their great expertise and experiences in the fields of climate change, forest ecosystems, biodiversity, biomass energy and bioproducts with us.

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Agenda

Time	***Activity***	***Location***
September 14, Monday		
08:00 – 22:00	Registration	Lobby, Beijing Xijiao Hotel
18:00 – 20:00	Welcome Dinner and Networking	Banquet Hall, Beijing Xijiao Hotel
September 15, Tuesday		
07:00 – 08:30	Breakfast	Xijiao Hotel
08:30 – 09:00	Opening Ceremony - Welcome and Introduction *Drs. Jingxin Wang and Xiuhai Zhao* - Opening remarks *President Weiming Song of BJFU*	Xueyan Building A0302, Beijing Forestry University (BJFU)
09:00 – 09:30	Group Photograph	In front of the Xueyan Building, BJFU
09:30 – 12:10	***Session 1 - Biodiversity and climate change (Moderator – Dr. Steve Running)***	Xueyan Building A0302, BJFU
09:30 – 10:00	The role of global forests in mitigating climate change and providing bioenergy *Dr. Steve Running, University of Montana, USA*	
10:00 – 10:30	The efforts in mapping plants in China *Dr. Keping Ma, Chinese Academy of Sciences, China*	
10:30 – 10:40	Coffee Break	
10:40 – 11:10	A new story from old trees: possible causes of a recent anomaly in tree growth in the Central Appalachian Mountains (USA) *Dr. Richard Thomas, West Virginia University, USA*	
11:10 – 11:40	Early post-fire regeneration of a fire-prone subtropical mixed pine forest in Yunnan, Southwest China: patterns and determinants for tree regrowth and species diversity *Dr. Zehao Shen, Peking University, China*	

11:40 – 12:10	An ecophysiological basis for quantifying the enhancement of sustainable forest biomass potential at different scales *Dr. David Par é, Canadian Forest Service, Canada*	
12:10 – 14:10	Group Lunch - Buffet	Beijing Xijiao Hotel
14:10 – 17:30	***Session 2 - Forest ecosystem services (Moderator – Dr. Keith Moser)***	Xueyan Building A0302, BJFU
14:10 – 14:40	Non-native invasive plants: Evaluating their presence, spread and relationship to present tree species diversity *Dr. Keith Moser, USDA Forest Service, USA*	
14:40 – 15:10	Forest management and carbon sequestration in southern subtropical planted forest ecosystem *Dr. Shirong Liu, Chinese Academy of Forestry, China*	
15:10 – 15:40	The ecological significance of forest management on the Mexican Sierra Madre Occidental *Dr. Juan Manuel Torres, Centro de Investigacion y Docencia Economicas, Mexico*	
15:40 – 16:00	Coffee Break	
16:00 – 16:30	Long-term observational managed plots within total area of 136 ha in Jiaohe, Jilin Province, northeastern China *Dr. Xiuhai Zhao, Beijing Forestry University, China*	
16:30 – 17:00	Branch architecture in young trees as a function of neighborhood tree diversity *Dr. Bart Muys, University of Leuven, Belgium*	
17:00 – 17:30	Soil carbon sequestration as an important component of forest ecosystem services: controls and underlying mechanisms *Dr. Osbert Jianxin Sun, Beijing Forestry University, China*	
18:00 – 20:00	Dinner	Chinese Restaurant (Koufuju Hot Pot Restaurant)

September 16, Wednesday		
07:00 – 8:30	Breakfast	Beijing Xijiao Hotel
8:30 – 12:00	***Session 3 - Forest biomass and bioenergy (Moderator – Dr. Dale Greene)***	Xueyan Building A0302, BJFU
8:30 – 9:00	A realistic view of the potential for biomass energy from private forests in the United States *Dr. W. Dale Greene, University of Georgia, USA*	
9:00 – 9:30	Forest carbon management: Tradeoffs and synergies among bioenergy, miomaterials and ecosystem storage *Dr. Tom Richard, Pennsylvania State University, USA*	
9:30 – 10:00	Cable yarding as contribution to multi-purpose forestry in China *Dr. Dirk Jaeger, University of Freiburg, Germany*	
10:00 – 10:20	Coffee Break	
10:20 – 10:50	How to prepare forestry students for a career in bio-economy *Dr. Siegfried Lewark, University of Freiburg, Germany*	
10:50 – 11:20	Modeling and optimization of woody biomass supply chains for bioenergy and bioproducts *Dr. Jingxin Wang, West Virginia University, USA*	
11:20 – 11:50	Production and diversity in the natural forests of Durango/Mexico *Dr. Klaus v. Gadow, University of Göttingen, Germany*	
12:00 – 13:00	Buffet	Beijing Xijiao Hotel
13:00 – 20:00	*Depart for field tour*	On flight CA1629 to Changchun (2 h), 1.5 h expressway and 40 min. national highway by bus
20:00 – 22:00	Dinner	Jiaohe Forestry Administration and Experimental Station (taste the Northeastern Chinese cuisine)

September 17, Thursday		
08:00 – 18:00	***Field Tour - Long-term natural forest ecosysem monotoring and management***	Jiaohe Forestry Administration and Experimental Station in Jiaohe, Jilin Province
08:30 – 09:00	Introduction of natural forest management in Jiaohe Forest Ecosystem Research Station *Mr. Tianxi Lin, Director of Jiaohe Forestry Administration and Experimental Station*	Conference Room
09:00 – 09:30	Introduction of the BJFU's observational study sites of long-term forest ecosysem monotoring and measurements *Dr. Xiuhai Zhao*	Conference Room
09:30 – 12:00	Leave for Site #1 – Natural forest of near maturity, tour the plots of selective cut in 2008, harvest intensity and soil respiration.	
12:00 – 13:30	Lunch – on site lunch box or picnic	
13:30 – 15:00	Leave for Site #2 - Management of mature natural forest, visit the comparative study of harvested plots in 2009, forest regeneration monitoring.	
15:00 – 17:00	Leave for Site #3 – Old-growth natural forest, examine the forest regenreration and the effects of the changes of landscape and terrain on forest.	
17:00	Back to the Jiaohe hotel	
18:00	Dinner	
September 18, Friday		
Morning	Return to Beijing	On flight CZ6193 to Beijing (2 h)
Afternoon	Tour of Beijing or shopping	
September 19, Saturday		
08:30 – 16:00	Tour of Beijing	Mutianyu Great Wall of China
18:00 – 20:00	Dinner and Meeting Adjourn	Chinese Restaurant (Quanjude Roast Duck)
September 20, Sunday		
	Departure of participants	Arrange transportation for participants to Beijing Capital International Airport

Presentation Abstracts

Session 1 - Biodiversity and climate change

The Role of Global Forests in Mitigating Climate Change and Providing Bioenergy

Steven W. Running

Department of Ecosystem and Conservation Sciences, University of Montana, USA

Abstract: Forests are an integral part of the global carbon cycle. Forest disturbances and deforestation are a carbon source to the atmosphere, while photosynthetic uptake and forest growth provide a carbon sink from the atmosphere. Additionally forest may provide a source for biomass derived energy that could substitute for some current fossil fuels. These factors provide a great opportunity to discover how to optimally manage the ecosystem services from our forests. Can the carbon sink potential be maximized and harvest biomass for energy? Can different forests be accurately evaluated for highest potential? Can global forests be monitored accurately? This presentation will address these questions and try to lay a conceptual foundation for answers.

The Efforts in Mapping Plants in China

Keping Ma[1], Zheping Xu[1], Bin Chen[2], Haining Qin[1] and Jinzhong Cui[1]

[1]Institute of Botany, Chinese Academy of Sciences, Beijing, China

[2]Shanghai Chenshan Botanical Garden, Shanghai, China

Abstract: Mapping of plants is one of the key steps for biodiversity planning, conservation and research as well climate change related studies. Distribution data are scattered in different sources such as specimens, literatures, observatories and so on. After the efforts of six decades, Flora of China (Chinese version) was completed with 80 volumes and 126 books in 2004, Flora of China (second version in English) was completed with 49 volumes in 2013 and 96 volumes of *Flora Sporophytae Sinicae* have been published so far. The first version of Catalogue of Life-China was formally released in 2008 and since then it has been updated every year with fully free access by both CD and a website (http://www.sp2000.cn/joaen/). There are 83290 taxa (73255 species & 10035 infra-specific taxa) in 2015 Annual Checklist of Catalogue of Life-China, including higher plants, vertebrates, spiders and some other invertebrates, some taxa of microbes. From early 2000s, we began digitizing specimens of plants, animals and fungi. Up to now, eight million plant specimens, 3 million animal specimens and a half million of fungi specimens have been digitized. A number of websites sharing such kind of data were launched. The National Specimen Information Infrastructure with 10.6 million digitized specimens (NSII, http://www.nsii.org.cn/) is the master website among them. Other websites include: Chinese Virtual Herbarium with 3.4 million digitized plant specimens (CVH, http://www.cvh.org.cn/), Chinese Field Museum with 6 million observations (color photos)(CFH, http://www.cfh.ac.cn/), Animal Specimen Information Sharing Platform with 2.9 million digitized specimens (http://www.nzmc.org/), and Biodiversity Heritage Library-China with 1.8 K digitized books associated with flora and fauna in China (BHL-China, http://www.bhl-china.org/bhl/). The on-line data sources are the baseline infrastructure for the initiatives in mapping plants in China.

A New Story from Old Trees: Possible Causes of a Recent Anomaly in Tree Growth in the Central Appalachian Mountains

Richard Baker Thomas

Department of Biology, West Virginia University, USA

Abstract: Forest ecosystems play a fundamental role in the global C cycle. Consequently, state-of-the-art climate models require a mechanistic understanding of how simultaneous changes in key environmental variables affect carbon cycling in trees and forest ecosystems. Dendrochronology, in combination with measurements of stable isotopes, can be useful in disentangling the environmental complexity of historical changes in forest productivity since tree rings provide an annually defined record of response to the environment. Prior to 1970, more than a century of fossil fuel use sharply raised atmospheric levels of both CO_2 and acid-rain producing sulfur dioxide. Assessing the consequences of these changes is not straightforward, however, as elevated CO_2 typically aids plant growth, while acid deposition produces numerous negative impacts on plants. Based on changes in isotopes in the tree rings, we were able to estimate how key physiological processes responded to changes in atmospheric chemistry during last century, finding that the trees are likely affected more by acid deposition than aided by the increased CO_2. This study has important implications for carbon cycling in forests, showing an interaction between decreasing SO_2 emissions and increasing CO_2 that is not currently accounted for in biosphere-atmosphere models of climate change.

Early Post-Fire Regeneration of a Fire-prone Subtropical Mixed Pine Forest in Yunnan, Southwest China: Patterns and Determinants for Tree Regrowth and Species Diversity

Zehao Shen

College of Urban & Environmental Sciences, Peking University, Beijing 100871, China

Abstract: Early stages of post-fire regeneration are sensitive to various factors, and can provide critical information in understanding forest responses to fire disturbance and subsequent forest succession dynamics. Yunnan pine forests are the most widespread conifer forest type in Southwest China, and are frequently threatened by fire disturbance. Post-fire regeneration of this forest type, however, has not been previously studied. In this study, we investigated the early stages of post-fire regeneration in mixed Yunnan pine forests five months after a severe burn in 2013 on Mt. Qinglongling, Yunnan Province, China. We found very active post-fire regeneration in the burned area likely facilitated by ample summer rainfall, with an average regeneration density of ~105 stems·ha^{-1}. Species composition of the post-fire regeneration was highly similar to the pre-fire community–the similarity between the pre- and post-fire communities was 0.530 ± 0.222. Elevation, pre-fire community type, and slope position were the three primary factors in the variations in regeneration density and species composition, while the impact of fire severity was low. The regeneration density of Pinus species and evergreen broadleaf species showed contrasting patterns across the environmental gradients, and the results implied that Yunnan forests are generally resilient to fire disturbance. The controlling impacts of the pre-fire community on post-fire regeneration are driven by the efficient regenerating strategies of dominant species, and are a comprehensive reflection of habitat conditions, which are primarily mediated by topographic features. Species regeneration strategies and the high resilience of the community to fire disturbance should be taken into account in fire prevention and management approaches for this forest type.

An Ecophysiological Basis for Quantifying the Enhancement of Sustainable Forest Biomass Potential at Different Scales

David Paré

Government of Canada, Natural Resources Canada, Canadian Forest Service, Laurentian Forestry Centre, Canada

Abstract: Producing more timber, fiber and energy from the forest as well as maintaining sinks could make a major contribution to reducing greenhouse gas emissions. However, estimating the amounts of biomass that can be produced and harvested without harming the environment has been the object of many studies and the estimates that have been produced vary widely. Based on theoretical considerations as well as empirical studies we will present figures on the amounts of biomass that are being harvested at the stand scales and incidence on soil sustainability. We will then, for large areas (countries), compare the ratios of forest biomass extracted (timber and energy) with net primary production (NPP). NPP sets the limit of theoretical biomass potential. The use of such ratios allows comparing different regions of the world having different intensity of management and different ecological, economic and social contexts using a standardized method. The overall picture generates useful information for defining a realistic potential for enhanced mitigation by forest management.

Session 2 - Forest ecosystem services

Non-native Invasive Plants: Evaluating Their Presence, Spread and Relationship to Present Tree Species Diversity

W. Keith Moser[1], Zhaofei Fan[2] and Mark H. Hansen[3]

[1]U.S. Forest Service, Rocky Mountain Research Station, USA

[2]Auburn University, School of Forestry and Wildlife Sciences, USA

[3]University of Minnesota, Department of Forest Resources and U.S. Forest Service, Northern Research Station, USA (retired)

Abstract: Species diversity in forested ecosystems is generally viewed positively in terms of forest health. The more species, the more likely the stand is ecologically stable (but not always). The more species, the better chance of providing suitable habitats for a wide range of forest inhabitants (but not always). The more species, the better chance to withstand attacks by insect and disease (but not always). The "but not always" encompasses a wide range of scenarios that prove exceptions to the rule, one of which is the presence of nonnative invasive plants. In a highly populated environment, we frequently view present biodiversity against a historical situation that is usually more desirable, i.e., present-day measures of diversity are often less than what was before. Such a past trend-line not only tells us how far we have come from some point in the past, but can also be used to extrapolate forward and tell us what might become in the future. In this study, we examine one method for evaluating a static inventory of selected invasive plants and speculate about past and future spread of these species. We also compare the presence of certain invasive plants with the number and species of tree regeneration.

Forest Management and Carbon Sequestration in Southern Subtropical Planted Forest Ecosystem

Shirong Liu

Chinese Academy of Forestry, China

Abstract: Planted forests are expanding throughout the world, and now account for 7% of global forest cover and provide more than 60% of global industrial round wood. China has been playing an important role in global expansion of planted forests while contributing to emission reduction from deforestation and forest degradation. Planted forests in China have undergone a continuous expansion in the past 20 years, which has significantly contributed to an increase in total forest cover and timber supply as well as other ecosystem services like carbon sequestration. The predominance of very few tree species in the plantations, uneven spatial distribution, skewed age-class distribution, low volumes in growing stock, and the increasing complexity for implementing multiple purpose forestry management under a changing environment, have generated several major challenges confronting the transition development of planted forests in China. Our experiments in subtropical area provide on-site demonstrations and useful knowledge on how to enhance ecosystem carbon sequestration while producing valuable timber by designing various silvicultural regimes focusing on native tree species. Carbon stock in biomass and soil increased with forest age in *C. hystrix* and *M. laosensis* planted forests. Mixed or broadleaf planted forests improve carbon storage in biomass, soil, and ecosystem than conifer plantation. Mixed plantation has higher soil organic carbon, and lower greenhouse gases emission than broadleaf plantations. Our experiments recommend that a strategic management transition of subtropical planted forests is needed, with a shifting emphasis from area expansion to stand productivity and quality enhancement, from traditional timber production to multi-purpose management for forest goods and services, and from monoculture plantations to multiple tree species mixed forests. A landscape-design approach and adaptive management practices should be also put in place to meet the diversified demands of stakeholders for different goods and ecosystem services while enhancing forest resilience under the changing climate.

The Ecological Significance of Forest Management on the Mexican Sierra Madre Occidental

Juan Manuel Torres-Rojo[1], José Javier Corral-Rivas[2], and Klaus von Gadow[3]

[1]CIDE Carr. México-Toluca No. 3655; col. Lomas de Santa Fe, México D.F. 01210, Mexico

[2]ISIMA, Universidad Juárez del Estado de Durango, Mexico

[3]Faculty of Forestry and Forest Ecology, University of Göttingen, Germany

Abstract: Multi-species natural forests are a particularly valuable resource which can deliver many products and services, in addition to timber, and their genetic diversity is likely to play a significant role in their ability to adapt to environmental change. Man has become a dominant part of nature, and human activities are not only destructive but have become increasingly creative in developing viable ecosystems that provide a range of benefits. The forests of the Sierra Madre Occidental in Mexico, which have been subject to intensive human use for more than a century, are a prominent example of community-based management of a highly valued natural resource.

Numerous studies have shown that specific management strategies can be more effective than mere protection in safeguarding and enhancing ecosystem services. Consequently, there is increasing interest in developing management methods aimed at 1) using existing natural forests more effectively, 2) rehabilitating overexploited natural forests and 3) re-converting unstable plantation monocultures to "near-natural" ecosystems.

In many biodiverse but economically disadvantaged countries, land use pressure has led to severe reduction of species richness. Because of the great variety of silvicultural systems and management intensities, it is almost impossible to draw general conclusions regarding the effect of management on species richness and ecosystem services. However, based on available evidence, it appears that the selectively managed forests of the Sierra Madre Occidental provide a rich assortment of ecosystem services, including bioenergy production. Based on local experience and an extensive database of permanent observational studies, we will discuss policies aimed at rehabilitating overexploited natural forests and present a new concept of using existing natural forests more effectively for providing multiple services and higher levels of bioenergy.

Long-term Observational Managed Plots within a Total Area of 136 ha in Jiaohe, Jilin Province, northeastern China

Xiuhai Zhao

Beijing Forest University

Abstract: The long-term observational plots of forest ecosystem monitoring have been established in Jiaohe Forestry Experimental Administration since 2008, and currently the total area of plots is 171 ha. Among those plots, there are seven forest managed plots and comparison plots with a total area of 136 ha, near-nature managed plots 15 ha, forest tending plots 10 ha, different cutting intensity plots 10 ha. In these plots, all the trees within diameter greater 1 cm were monitored measured, including DBH, tree height, crown area, and spatial position, etc. The reinvestigations of the plots were planned to be conducted every five years since the initial measurements of the plots being accomplished in 2014 and 2015 with a total area of 136 ha. The main research activities being carried out in those plots include forest biodiversity monitoring, forest productivity monitoring, and ecological process after forest management, etc.

Branch Architecture in Young Trees as a Function of Neighborhood Tree Diversity

Bart Muys[1], Thomas Van de Peer[1], Elisa Van Cleemput[1] and Kris Verheyen[2]

[1]KU Leuven, Division of Forest, Nature and Landscape, Belgium

[2]Ghent University, Department of Forest and Water Management, Forest & Nature Lab, Belgium

Abstract: Branch architecture of young trees, including first order branchiness, branch diameter and insertion angle, are relevant variables for later stem quality and economic value of a tree. So far, only few models on branch characteristics in early forest stages have been developed. In addition, these studies were conducted in monoculture environments, while mixed forests are increasingly preferred in sustainable forest management. The aim of this research was to test effects of neighborhood diversity and identity on branch architecture of young trees.

Based on observations in a young tree diversity experiment we developed species-specific mixed regression models for branchiness, branch diameter and branch insertion angle in *Quercus robur* L., *Fagus sylvatica* L., *Betula pendula* Roth., *Pinus sylvestris* L. and *Tilia cordata* Mill., five common tree species in West European forests. Data were collected at the FORBIO experiment, a five year old tree diversity experiment in Belgium (www.treedivbelgium.ugent.be). For 400 target trees, we measured variables at tree-level (tree height, stem diameter and crown size) and at branch-level (height, length, diameter, azimuth and insertion angle of first order branches). The target tree's neighborhood was defined by surrounding trees' identity and dimensions (height, stem diameter and crown size).

Provisional results indicate branchiness was influenced by the competitive pressure of the neighborhood but not directly by tree diversity. However, when overall competition was partitioned into species-specific competitions, results support the idea that branchiness was modified differently by neighboring species. We conclude inter- and intra-specific environments shape branching patterns of young plantation trees, but neighborhood species composition rather than diversity per se drives the morphological plasticity. Together with models on branch diameter and branch insertion angle, the ecological and silvicultural implications of this work are further discussed.

Soil Carbon Sequestration as an Important Component of Forest Ecosystem Services: Controls and Underlying Mechanisms

Osbert Jianxin Sun

Institute of Forestry and Climate Change Research, Beijing Forestry University, China

Abstract: Forests are perceived as the leading player among the terrestrial ecosystems for mitigating global climate change by storing majority terrestrial carbon in both biomass and soil. Soil carbon represents the relatively more stable form and sustained pool of carbon stocks in forest ecosystems, but direct accounting and monitoring of changes in soil carbon stocks are technically constrained. Explicit understanding on the processes and controls of the formation and transformation of soil organic carbon can help with devising approaches enabling quantitative assessment of spatiotemporal dynamics of soil carbon stocks, e.g. development of mechanistic models on the pathways for soil organic carbon transformation and turnover with changing forest vegetation and environmental conditions. Several experiments were conducted in my research group to determine variations in soil carbon composition and stocks in relation to climate, forest types, and soil physiochemical traits, aiming to gain better understanding on the controls of key biotic and environmental factors on soil carbon decomposition and storage in forest ecosystems. This talk illustrates some of the preliminary findings from our studies and their implications to terrestrial carbon sequestration as a functional trait of forest ecosystems.

Session 3 - Forest biomass and bioenergy

A Realistic View of the Potential for Biomass Energy from Private Forests in the United States

W. Dale Greene

Warnell School of Forestry and Natural Resources

The University of Georgia, Athens, GA 30602-2152 USA

Abstract: The wood supply system in the United States is adjusting to include biomass harvesting. Sources of this biomass include currently unused trees and tree components as well as trees currently sought by traditional users such as pulp and panel markets. Biomass markets are highly sensitive to government programs that mandate or subsidize its use as well as the price of competing energy sources. Markets are likely to continue to strengthen, perhaps quickly and significantly if proposed policies mandating greater use of renewable energy and limitation of carbon emissions are adopted in the US. Current harvesting systems and methods can be modified in several ways to efficiently harvest, collect, and deliver additional woody biomass for bioenergy and bioproducts. The collection method must produce biomass that meets quality and delivered cost targets while not significantly reducing the production of higher-value roundwood products. Landowners and forest managers should understand harvesting options for small stems and harvesting residues when planning timber sales and revising forest management plans.

Forest Carbon Management: Tradeoffs and Synergies among Bioenergy, Biomaterials and Ecosystem Storage

Tom L. Richard

Penn State Institutes of Energy and the Environment

Pennsylvania State University, USA

Abstract: Forests are the climax ecosystem for many terrestrial landscapes and store substantial amounts of carbon. By deploying photosynthesis on a 3D platform, trees use solar energy to capture carbon dioxide efficiently, even at the relatively dilute concentrations in the atmosphere today. The young forests that have been logged in recent decades accumulate carbon at an extremely rapid rate, but as a forest matures, the rate of net carbon accumulation decreases. At quasi-steady-state, the net carbon accumulation of a mature forest eventually declines to zero, or even becomes negative when exacerbated by fire, disease, and other factors associated with our changing climate. Management for saw timber, pulpwood and bioenergy can keep forests in a state of rapid carbon accumulation indefinitely, transferring much of the carbon captured by photosynthesis into bio-based materials or energy that substitute for greenhouse gas (GHG) intensive concrete, steel, and fossil fuels. These substitution benefits of forest products can effectively reduce CO_2 emissions, but this result is not absolute and depends on the efficiency of both the bio-based and the fossil-based technologies. This paper will discuss important factors that affect the net GHG impact of managing forests for bioenergy, biomaterials, and ecosystem storage in the NE United States.

Cable Yarding as Contribution to Multi-purpose Forestry in China

Dirk Jaeger, Stephan Hoffmann, Siegmar Schoenherr

Chair of Forest Operations of University of Freiburg, Germany

Abstract: After extended deforestations until the 1960s in China with all its negative impacts, enormous forest protection and afforestation programs were successfully implemented. With increasing need for timber resources for material and energy use and aging plantations with tree dimensions attractive for commercial utilization, new focus is given to innovative timber harvesting and, in particular, extraction techniques. Methods are wanted which are economic, increasing safety of operating personnel and environmentally friendly. For this reason, the Chair of Forest Operation introduced new extraction technology for timber transport from stand to landing in steep terrain in southern China by importing an Austrian made standing skyline system to Guangxi Province in 2013. Since then the system's implementation was supported by professional training and operations were monitored by time and motion studies as well as through self-monitoring of the operating personnel via logbooks. This allowed a detailed analysis of operating conditions and identification of factors determining operations' success. In addition, common tree species of plantations were analyzed with respect to use for bioenergy. Pellets were produced and tested against European standards for wood pellets used for heating purposes. The presentation gives an overview of applied methods and first results of the overall study.

How to Prepare Forestry Students for a Career in Bioeconomy

Siegfried Lewark

Albert-Ludwigs-Universität Freiburg, Germany

Abstract: Bioeconomy is a term for political initiatives of the EU and of the USA. Bioeconomy is not a traditional academic discipline, nor are biodiversity or forest ecosystem services. But as political concepts of great actual relevance for the use of forest resources of course all three fields of knowledge are traditional parts of forestry education.

As graduate analyses show, forest sciences graduates have for long time already had jobs in fields to be regarded as bioeconomy. They must have adequate competences in these fields, as probably many more of them will have jobs outside of the narrow field of forestry.

So how to prepare the forestry students even better for such work? Let's have a closer look at the formal education, i.e. education, which we, as university teachers, organize in the study programs of universities. We must look for answers to the following questions: what are the competences needed for jobs dealing with forest ecosystem services? Do students already learn what they will need later – what may be missing? How to transform learning needs into expected learning outcomes (ELO)? How to organise teaching and learning in order to reaching the ELO? How to assess the results of learning and teaching? How to organise the cooperation of formal education and working life? How to motivate our students to think of the jobs ahead of them while learning? I will attempt to give some answers or indications of where to look for answers. I will present and discuss examples of good learning and teaching practice – thereby trying to stimulate reflection and discussion.

Modeling and Optimization of Woody Biomass Supply Chains for Biofuels and Bioproducts

Jingxin Wang

West Virginia University, Morgantown, WV 20506 USA

Abstract: While woody biomass derived from forests and short rotation woody crops (SRWC) is a potential feedstock for a diverse set of energy and bioproduct development options, more emphasis needs to be placed on developing supply chains to efficiently deliver the resource to the end users. This study developed a mixed integer linear programming model to efficiently configure woody biomass supply chains and optimize the harvest, extraction, transport, storage and preprocessing of woody biomass resources to provide the lowest possible delivered cost. The characteristics of woody biomass, such as spatial distribution and low bulk density, tend to make collection and transport difficult as compared to traditional energy sources. These factors, as well as others, have an adverse effect on the cost of the feedstock. The average delivered cost was found to be between $64.69-98.31 for the base scenario. The effect of resource availability and required demand was examined to determine the impact that each would have on the total cost. Through sensitivity analyses of case scenarios, the optimized siting of facilities and their respective capacities were determined along with the configurations of the woody biomass supply chains for the development of biomass energy and bioproducts.

Production and Diversity in the Natural Forests of Durango/Mexico

Corral Rivas, J.S.[1], Lujan Soto, J.E.[1], Nava Miranda[1], Aguirre Calderón, O.A.[2] and MG, Gadow, K.v.[3]

[1]Universidad Juárez del Estado de Durango, México

[2]Universidad Autonóma de Nuevo León, México

[3]Georg-August Universität Göttingen, Germany; University of Stellenbosch, South Africa

Abstract: Multi-species natural forests are a particularly valuable resource which can deliver many products and services, in addition to timber. A prominent example of such natural ecosystems are the communal forests of the Mexican Sierra Madre Occidental. Based on evidence gathered in long-term observational studies in Durango/Mexico, the objective of this contribution is a) to provide estimates of forest production in response to specific residual levels of forest density and b) to present an approach to ensure that species diversity is maintained. Assmann's Optimum Density Theory was found to be applicable and equations are presented which permit an evaluation of production losses due to reduced stocking levels in the municipios Santiago Papasquiaro, San Dímas and Pueblo Nuevo. Potentially considerable production gains are illustrated for the ejido San Diego de Tezains where detailed compartment data are available. In addition, a method of grouping tree species into functional cohorts is introduced. The method, which is based on vertical stratification and height-growth ordenation, identifies mature and immature canopy species, and subcanopy specialists. The results regarding potential production gains and simultaneous maintenance of species diversity provide a new basis for improved control of residual forest structures following harvesting. The method is explained by means of examples.

Invited Speakers

Dr. Gadow, Klaus von
University of Gottingen, Germany
Email: kgadow@gwdg.de

Dr. Klaus v. Gadow is an extraordinary professor at the University of Stellenbosch, a retired professor at the *Georg-August-University* in Göttingen, and an International Scholar appointed by the Ministry of Education of the Peoples Republic of China. His research focus is the structure and dynamics of natural forests. He is Editor in Chief of the book series *Managing Forest Ecosystems* and of the *Open Access* journal *Forest Ecosystems* and has authored 22 textbooks and more than 150 scientific publications, mostly in refereed international journals. His career in teaching and research includes extended periods at the Faculty of Forestry, *University of Stellenbosch* (13 years) and at the *Georg-August-University* in Göttingen (15 years), and half-yearly visiting professorships at the *University of Athens* in the USA and at the *University of Santiago de Compostela* in Spain. Dr. v. Gadow is a member of the *Royal Swedish Academy of Agriculture and Forestry*. He has been awarded an honorary professorship by the *Chinese Academy of Forestry*, Beijing and an honorary doctorate by the *Estonian University of Life Sciences* in Tartu. During recent years he has presented workshops to senior students at Universities und Research Institutes in Finland, China, Estonia, Russia, Spain, Mexico, South Afrika, India and Ukraine.

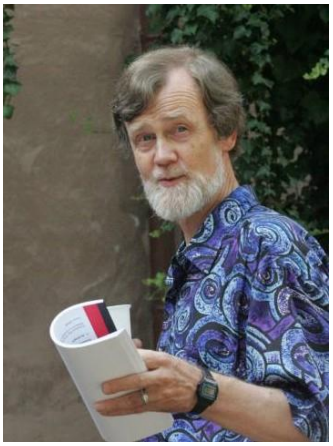
Dr. Greene, W. Dale
University of Georgia, USA
Email: wdgreene@uga.edu

Dale Greene became Dean of the Warnell School of Forestry & Natural Resources in 2015 after a 29-year research and teaching career that focused on improving the timber harvesting and forest operations elements of the wood supply chain. Dale was twice appointed by Georgia Governors to the Georgia State Board of Registration for Foresters and he is a long-serving member of the Board of Directors of the Georgia Forestry Association. His recognitions include teaching awards at both UGA and Clemson, the Outstanding Research Award from the Southeastern Society of American Foresters, and the Wise Owl Award from the Georgia Forestry Association. Dale earned his B.S. from LSU, M.S. from Virginia Tech, and Ph.D. from Auburn. Outside of work, he and his family are active at Athens First United Methodist Church, with Scouting in the Athens area, and in the management of their forestland in Georgia and Arkansas.

Dr. Jaeger, Dirk

Chair of Forest Operations
Albert-Ludwigs-University Freiburg, Werthmannstraße 6
D-79098 Freiburg, Germany
Email: Dirk.jaeger@fobawi.uni-freiburg.de

Dr. Jaeger is Professor and Chair of Forest Operations at the the University of Freiburg, Germany. Her served in the German Military in 1984 and received a Full-year internship at Community Forest District of Wuppertal University studies in 1985. Dr. Jaeger received Diplom-Forstwirt and a Ph.D. in Forestry at the University of Gottingen, Germany. Before he joined the faculty at the University of Freiburg, he worked as Assistant Professor (wissenschaftlicher Assistant) at the Institute of Forest Engineering at the University of Gottingen, Germany; Associate Professor in Forest Engineering at the University of New Brunswick (UNB), Canada. He also served as a Program Officer at the United Nations University Bonn, Germany. Dr. Jaeger have been serving as a Project coordinator on afforestation of semi-arid regions in China.



Dr. Lewark, Siegfried
University of Freiburg, Germany
Email: siegfried.lewark@fobawi.uni-freiburg.de

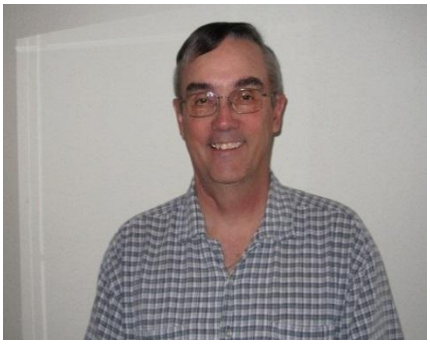
Siegfried Lewark, Professor of Forest Work Science, Faculty of Environment and Natural Resources, University of Freiburg, Germany, since 1990; since 2002 concurrent professor, since 2012 distinguished professor at the Forest University of Nanjing, China. Recent research tasks included innovative potential of forest entrepreneurs, knowledge management in forestry, health and safety of forest workers, organizational culture and gender issues in state forest services and modern communication media for university training in developing countries by development of exemplary internet teaching modules, based on research with focus on work science and educational theory as well as gender issues. He has held many positions within university as well as international networks of forest sciences (IUFRO, SILVA Network) and has been honored with different awards in Germany and on international level.

Dr. Liu, Shirong
Chinese Academy of Forestry, China
Email: liusr@caf.ac.cn

Professor & Dr. Shirong LIU, is the chief research scientist in Forest Ecology and Hydrology, the vice president of Chinese Academy of Forestry. He was graduated in 1990 with PhD majoring in forest ecology at the Northeast Forestry University, PR. China. During Jan. 1994 - Jan. 1995**,** He was at the Institute of Ecology and Resource Management, the University of Edinburgh, UK, as a Post-doctoral Fellow, working on impacts of climate change on forests and trees. During Oct. 1995 - April 1996, he was at the College of Forest Resource, North Carolina State University, USA, as a visiting scholar, working on protected areas management and biodiversity conservation. Dr. Shirong is a board member of IUFRO (2010-2014) and the coordinator for Task Force of Forest and Water Interaction of IUFRO, the Director-general of Ecological Society of China, and Chairman of the Association of Forest Ecology, Forestry Society of China. His current research interests are ecosystem N and C processes, eco-hydrology, landscape restoration and management, and climate change in relation to forests.

Dr. Ma, Keping
Chinese Academy of Sciences, China
Email: kpma@ibcas.ac.cn

Dr. Keping Ma is a professor of plant ecology in Institute of Botany, Chinese Academy of Sciences, Chairman of IUCN Asia Regional Member Committee, and Secretary General for Chinese National Committee of DIVERSITAS, and Editor-in-Chief for ***Biodiversity Science***. His research is mainly focused on biodiversity and its conservation. He initiated the establishment of Chinese Forest Biodiversity Monitoring Network (CForBio); By the end of 2014, 13 permanent plots and 60 associated plots with an area bigger than 1 ha have been set up in CForBio and, the total plot area is over 340 ha; CForBio monitors the growth and survival of approximately 1.5 million trees and belonging to 1,600 woody species that occur in the forest plots; More than 200 papers based on CForBio data have been published in academic journals. Cooperating with German and Swiss colleagues, he and his Chinese colleagues established a platform of Biodiversity and Ecosystem Function (BEF-China) to study the effects of biodiversity loss on ecosystem function and services;, the total plot area is over 50 ha and 0.3 million trees planted. Over 60 papers based on the platform BEF-China have been published in SCI journals. He initiated digitization of specimens in China, set-up of NSII, CVH and Catalogue of Life-China. He attended most of the meetings of conference of parties (COP) to Convention on Biological Diversity and its related extra-COPs and working group meetings on thematic issues as a scientific advisor to Chinese delegation. He also participated in evaluations on many nature reserves and national parks in China and gave lectures and conservation advices to nature reserve managers.



Dr. Moser, Keith
USDA Forst Service, USA
Email: wkmoser@fs.fed.us

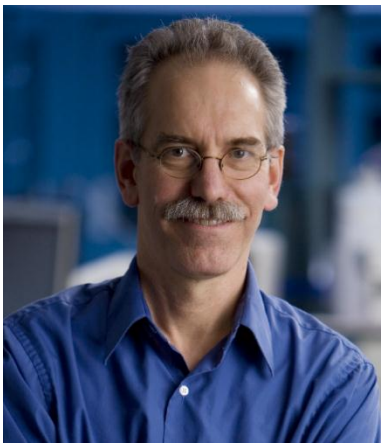
Since 2013, Dr. W. Keith Moser has been a research forester with the USDA Forest Service, Rocky Mountain Research Station in Flagstaff, Arizona, where he is the Scientist-in-Charge of the Fort Valley Experimental Forest, the oldest forest research site in the agency. He is interested in understanding how species respond and adapt to disturbance in nature, share or compete for resources, and what characteristics of the species' biology are important in species replacement and ecosystem stability, and particularly how management actions can take advantage of these processes to achieve the landowner's goals.
Dr. Moser has worked for the USDA Forest Service for over 12 years, including 10 years with the Forest Inventory and Analysis unit in St. Paul, Minnesota. Before that he worked for the Missouri Department of Conservation in Columbia, Missouri, and Tall Timbers Research Station in Tallahassee, Florida. Dr. Moser has a B.A. in Business Management from North Carolina State University, a M.B.A. and a Master of Forestry from Duke University, and a Doctor of Forestry from Yale University. Dr. Moser has worked for two Fortune 100 corporations and was a paratrooper in the 82nd Airborne Division. He was the 1994 recipient of the Thurn and Taxis Förderpreis at Ludwig Maximilian University in Munich, Germany; a prize awarded to one promising forestry doctoral graduate each year.

Dr. Muys, Jozef Bart
University of Leuven, Belgium
E-mail: bart.muys@ees.kuleuven.be.

Prof. Dr. ir. Bart Muys is leading the research group on Forest Ecology & Management at KU Leuven since 1997. He has a master's degree in forestry and a PhD in forest ecology. His research is focusing on optimizing forest management and management of woody bioenergy systems for multiple ecosystem services. He participated in several international projects focusing on indicators and decision support systems for sustainable forest management, mainly in Europe and Africa (e.g. AFFOREST, ENCOFOR, SIMFORTREE, KLIMOS, FUNDIVEUROPE, TREEDIVNET, JATROPHABILITY, FORBIO, and FORMIT). Recent research evaluates the role of biodiversity for forest function and ecosystem services.

Dr. Par é, David
Canadian Forest Service, Canada
Email: David.Pare@RNCan-NRCan.gc.ca

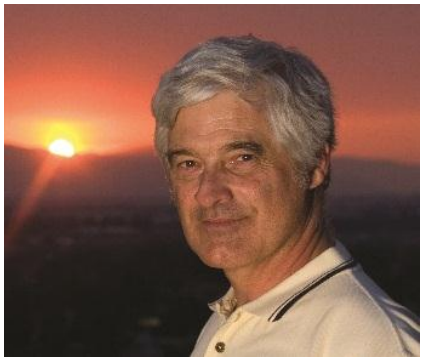
David Par éleads a research program in biogeochemistry and productivity of forest ecosystems at Natural Resources Canada and holds the status of adjunct professor at the CEF (Centre for forest Ecology) a grouping of several Canadian Universities. His research work aims at providing a better understanding of the impact of forestry practices and natural disturbances on soils, on the carbon cycle and on forest productivity. He has worked on the development of indicators designed to assess the amounts of forest biomass that can be sustainably harvested and on the development of methodologies for assessing the greenhouse gas (GHG) mitigation potentials of forest bioenergy. He is forest engineer by training (U. Laval), he earned a M. Sc in forest ecology from the same institution and holds a PhD in forest soils from the University of Alaska-Fairbanks. Author of more than a hundred scientific papers, he serves on various national and international technical committees and panels as a scientific expert on forest sustainability and GHG accounting. He served as Review Editor for the Bioenergy chapter of the IPCC (Intergovernmental Panel on Climate Change) special report on Renewable Energy (SRREN) as well as on the IPCC report on greenhouse gas accounting for wetlands. He is the former Chair of the Atmospheric Change working group of the FAO North American Forest Commission. Since 2014, he has been serving as an Adjunct Professor at the University of New Brunswick.



Dr. Richard, Tom,
Pennsylvania State University, USA
Email: trichard@psu.edu

Director, Penn State Institutes of Energy and the Environment**,** Professor of Biological Engineering, Penn State University**,** University Park, PA 16802

Tom Richard is a professor of agricultural and biological engineering and the Director of Penn State's Institutes for Energy and the Environment (PSIEE), where he coordinates a network of almost 500 faculty engaged in innovative interdisciplinary research. Dr. Richard currently directs the $10 million NEWBio Sustainable Bioenergy Consortium for the USDA's National Institutes of Food and Agriculture, and serves as the deputy technical director for the DOE's National Risk Assessment Partnership for carbon sequestration. He has over 25 years research experience in biomass supply chains, processing, and energy applications, and has consulted for six companies, regulatory agencies in nine states, four federal agencies and the World Bank. Dr. Richard is the author or co-author of over 140 research and technical publications and is a Fellow and Past President of the Institute of Biological Engineering. He has a B.S. from the University of California at Berkeley, and M.S. and PhD degrees from Cornell University.



Dr. Running, Steven W
University of Montana, USA
Email: swr@ntsg.umt.edu

Steven W. Running received his Ph.D. in Forest Ecology from Colorado State University and has been with the University of Montana, Missoula since 1979, where he is a University Regents Professor of Global Ecology. His primary research interest is the development of global and regional ecosystem biogeochemical models integrating remote sensing with bioclimatology and terrestrial ecology. He is the Land Team Leader for the NASA Earth Observing System, Moderate Resolution Imaging Spectroradiometer, and is responsible for the EOS global terrestrial net primary production and evapotranspiration datasets. He has published more than 280 scientific articles and two books. He was a co-Lead Chapter Author for the 2014 U.S. National Climate Assessment. He currently Chairs the NASA Earth Science Subcommittee, and is a member of the NASA Science Advisory Council. Dr. Running was a chapter Lead Author for the 4th Assessment of the Intergovernmental Panel on Climate Change which shared the Nobel Peace Prize in 2007. Dr. Running is an elected Fellow of the American Geophysical Union, has been designated a Highly Cited Researcher by the Institute for Scientific Information, and in 2014 was designated one of "The World's Most Influential Scientific Minds" in Geosciences. In the popular press, his essay in 2007, "The 5 Stages of Climate Grief" has been widely quoted.

Dr. Shen, Zehao
Peking University, China
Email: shzh@urban.pku.edu.cn

Dr. Zehao Shen is an associate professor of Department of Ecology at Peking University, and the vice general secretary of Ecology Society of China. He received his Bachelor and M.S. in physical geography at East China Normal University, and received his Ph.D. in Ecology from the Institute of Botany, Chinese Academy of Sciences. His research interests include landscape ecology, phytogeography and biodiversity, climate change impact on alpine treeline dynamics, forest fire ecology and management. Dr. Shen has authored or coauthored around 100 peer reviewed papers, books and chapters. Currently, he is a leading PI for two NSF China projects. He has served as editorial board member or associate editor for two academic journals. He is an active member in International Society of Biogeography and International Association of Landscape Ecology.

Dr. Sun, Osbert Jianxin
Beijing Forestry University, China
Email: sunjianx@bjfu.edu.cn

Dr. Osbert Jianxin Sun is Professor in Forest Ecology and Ecosystem Science and advisor of doctoral candidates at Beijing Forestry University. He also serves on the editorial board of *Ecological Processes* (Associate Editor-in-Chief), *Forest Ecosystems* (Senior Editor), *Journal of Plant Ecology* (Associate Editor), and *Forest Ecology and Management* (member of editorial advisory board), and on the Scientific Committee of the State Key Laboratory of Forest and Soil Ecology at Institute of Applied Ecology of the Chinese Academy of Sciences. His primary research interest concerns temperate forest ecosystem processes and functioning from stand level to landscape scale.
Dr. Sun graduated with a B.Agr.Sci. from Inner Mongolia Agricultural University in China in 1982, and earned a Ph.D. in Forestry at University of Canterbury in New Zealand in 1994. His previous professional experience includes a five year service as a Research Scientist at New Zealand Forest Research Institute (1994 – 1999), with research focus on environmental constraints on forest productivity, three years as a Research Associate at Oregon State University (2001 - 2003) with research focus on forest ecosystem carbon balance as affected by forest type and climate, and more than three years as Professor and Group Leader at Institute of Botany of Chinese Academy of Sciences with research focus on responses of grassland ecosystem to climate change and land use. So far he has published more than 60 research articles in international journals such as *Global Change Biology*, *Functional Ecology*, *New Phytologist*, *Ecosystems*, *Landscape Ecology*, and *Biogeochemistry*, etc.

Dr. Thomas, Richard B.
West Virginia University, USA
Department of Biology
Morgantown, WV 26506
Email: rthomas@wvu.edu

Dr. Richard Thomas is a Professor of Biology at West Virginia University in Morgantown, WV. A graduate of Clemson University (PhD), he is a plant ecologist who has been studying the potential effects of climate change on plant physiology and ecology for over 25 years.

Dr. Thomas has had extensive collaboration with the Duke Free Air CO_2 Enrichment (FACE) experiment as a core scientist since the planning stages in 1994. The purpose of this internationally-known experiment was to determine how forest carbon balance might be affected by increased levels of atmospheric CO_2 due to fossil fuel combustion. For almost 15 years, this experiment enriched a pine forest with atmospheric CO_2 at concentrations expected in the year 2050 in order to examine the carbon cycle of an intact forest.

Since the conclusion of the Duke FACE experiment, Dr. Thomas has begun to examine the role of central Appalachian forests in the global carbon cycle. Using a variety of approaches, including dendrochronology, he and his students have been estimating net primary productivity of spruce forests along a nitrogen deposition gradient in West Virginia. Another project just under way uses dendroisotopic techniques to compare historical tree growth and physiology in temperate deciduous forest of the eastern U.S. and China, two regions with vastly different histories of acidic air pollution.

Dr. Thomas is the author or coauthor of 60 scientific papers and findings from his research are providing information for atmospheric scientists, ecologists, and policy analysts on the role of forest ecosystems in the global carbon cycle as the Earth's climate continues to change in the future.

Dr. Torres-Rojo, Juan Manuel
Centro de Investigacion y Docencia Economicas, Mexico
Email: juanmanuel.torres@cide.edu

Juan Manuel Torres-Rojo is a professor at the Center for Research and Teaching of Economics (CIDE) where he also has been Head of the Department of Economics and currently Secretary General. He has a BSc in Forestry (1982) from Universidad Autonoma Chapingo, and an MSc (1987) and a PhD (1990) from Oregon State University. From 1992-1993 he was appointed as the Director of the Mexican National Program of Reforestation; and from 2009-2012 he was the General Director of the National Forestry Commission of Mexico. He has been visiting research at the Center for International trade in forest products in Seattle; the Rosenstiel School of Marine and Atmospheric Sciences, Miami, FL, the "Institut für Waldinventur und Waldwachstum, Georg-August-Universität, Göttingen, Germany, and the Department of Agricultural and Resource Economics at the UC Berkeley.
He is author and coauthor of several research papers (48), book chapters (29), and books (5) related to Forestry issues, particularly to forest management and the economics of Forestry. He has also belonged to the Advisory Group of the Environnement, Économie, et Commerce, Commission de Coopération Environnementale (2003-2005) and the National Commission for the Biosecurity of GMO's, (2008-2009). He has contributed to reports for FAO, the World Bank, Inter-American Bank and CEPAL.

Dr. Wang, Jingxin
West Virginia University, USA
Email: jxwang@wvu.edu

Dr. Jingxin Wang is Professor and Associate Director for Research, and the Director of Renewable Materials and Bioenergy Research Center in the Division of Forestry and Natural Resources at West Virginia University, USA. He received his degrees in Forest/Mechanical Engineering from Northeast Forestry University, China. He received a M.S. in Computer Science from West Virginia University, and a Ph.D. in Forest Resource Management from the University of Georgia, USA. His research interests include biomass energy and bioproducts, carbon sequestration and optimization, computer simulation and system modeling, and forest ecosystem management. Dr. Wang has authored or coauthored 132 refereed papers, and 12 books or book chapters over 25 years of his career. Currently, he is a leading PI for seven USDA and USDOE biomass energy and bioproducts projects. He has served as an editorial board member or associate editor for four international journals and adjunct professor for three Chinese universities. He is an active member in six international professional societies.

Dr. Xiuhai Zhao
Beijing Forestry University, China
Email: zhaoxh@bjfu.edu.cn.

Xiuhai Zhao is a professor of forest ecology in College of Forestry at Beijing Forestry University. His major appointments include (1) the director of the Journal Editorial Department at Beijing Forestry University since 2012, (2) the director of Taiyue Mountain Forest Ecosystem Research Station of State Forestry Administration since 2007, (3) professor at Beijing Forestry University since 2002.
Dr. Zhao's main research areas cover Forest Ecology and Forest Management. He has started long-term and large-scale observational studies of forest dynamics since 2005. His research interests include community dynamics, ecosystem management and mass cycling of forest ecosystems. Prof. Zhao has established three forest ecological observational transects in western, central and northeastern China, i.e. Spruce/Fir forests transect in the western China from northwest to southwest, Chinese pine forests transect in the central China from north to south, and mixed broadleaved-Korean pine forest transect in the northeastern China from north to south. In this observational network, 35 permanent plots have been established with a total area of 345 hectares, and more than one million trees with diameter greater than 1cm tagged, measured, and mapped.

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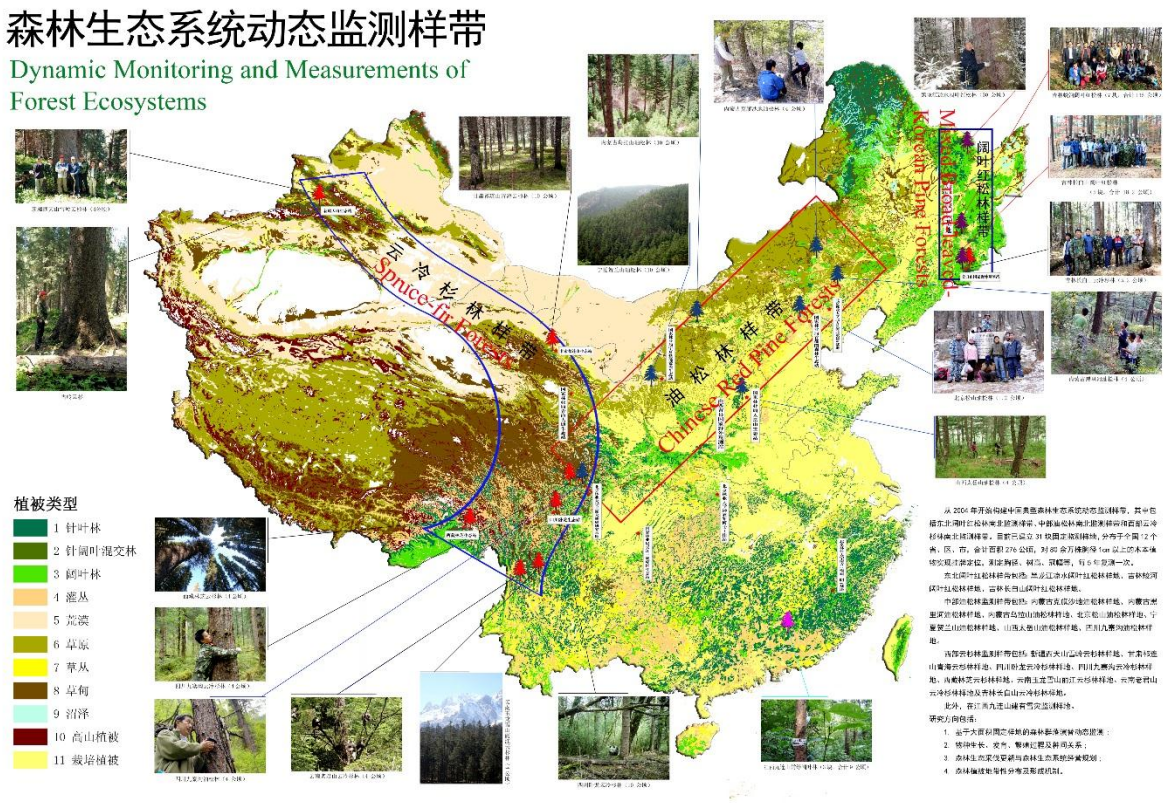

Workshop Coordinators
Ms. Hui Li, lihui@bjfu.edu.cn, bjfulihui@gmail.com
Dr. Klaus v. Gadow, kgadow@gwdg.de
Dr. Xiuhai Zhao, bfuz@163.com
Dr. Jingxin Wang jxwang@wvu.edu

Beijing Forestry University
http://www.bjfu.edu.cn

West Virginia University
Renewable Materials and Bioenergy Research Center
http://bioenergy.wvu.edu