INTERNATIONAL SCIENTIFIC CONFERENCE

FORESTRY: BRIDGE TO THE FUTURE

90 Years
Higher Forestry Education in Bulgaria

6–9 May 2015, Park Hotel Moskva,
Sofia, Bulgaria

Book of Abstracts

Sofia, 2015

Editors: Milko Milev, Petar Zhelev, Krasimira Petkova, and Marius Dimitrov

Language editors: Petar Zhelev, Nikolina Tzvetkova, Svetoslav Anev, Momchil Panayotov, Youlin Tepeliev, Genoveva Tzolova, Stefan Mirchev, and Stoyan Stoyanov

Technical editor: Toma Tonchev

Pre-pres: Magdelina Bozhankova

Cover design: Emil Galev

Publishing House of the University of Forestry

Printed by Intel Entrans

The International Scientific Conference "Forestry: Bridge to the Future" is financially supported by the Ministry of Agriculture and Food of Bulgaria, Ministry of Education and Science of Bulgaria and other sponsors, presented on pages 8–10.

ISBN 978-954-332-134-6
University of Forestry
Sofia, Bulgaria

WELCOME ADDRESS

Dear Colleagues and Friends,

Ladies and Gentlemen,

It is a great pleasure and honour for me to welcome you to the International Scientific Conference "Forestry: Bridge to the Future", dedicated to the 90th anniversary of higher forestry education in Bulgaria.

We are glad to host this scientific event, which provokes substantial interest and put together more than 100 scientists from twenty-three countries from all over the World. The interest to the Conference underlines the significance of forests and forestry and reflects the attention of the international scientific community. The Conference will be a good occasion for participating scientists to present the results of their research work and to share their opinions and experience with the colleagues from many different countries, as well as to bring together academic researchers and business practitioners from the forestry sector.

Main focus of the Conference is the global climate change and its effect on forests and forestry in general. This is related also to the other ecological problems and challenges, such as environmental pollution, soil degradation, desertification and deforestation. All these topics concern forests and forestry. The forests react sensitively to a changing climate. They have the potential to absorb the carbon emissions into their biomass, soils and products, and to store them. Therefore, it is of particular importance to study Forestry and share information and good practices among the scientists and professionals from different countries.

The international and local organizing committees of the Conference have prepared a diverse scientific programme including invited speakers, and voluntary report and poster presentations. The agenda is well-balanced, combining various scientific topics and social events.

Many of the participants are university professors and lecturers, and we have more than 30 students and PhD students from 7 countries. This is a prerequisite for one more important gain – the new scientific achievements will reach the

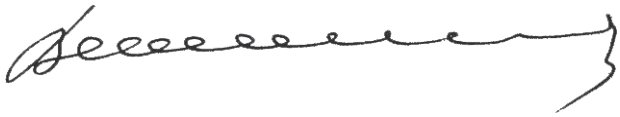
teaching programmes. Therefore, I believe that our Conference creates a strong bridge to the better future of our forests and nature, for our present and future societies.

I hope also that you will enjoy the social programme containing number of different events to satisfy both delegates and their companions. I believe you will learn new things about Bulgaria and will bring home excellent impressions of our country.

Finally, on behalf of the Organizing Committee, I would like to express my best wishes to you for a successful work and fruitful stay in Bulgaria.

With cordial greetings,

Chair of the Organizing Committee



Professor Dr. Veselin Brezin
Rector of the University of Forestry

ORGANIZING COMMITTEE

Chairman: Prof. Dr. Veselin Brezin – Rector
Vice Chairman: Assoc. prof. Dr. Milko Milev – Dean
Secretary: Assoc. prof. Dr. Peter Zhelev – Vice-rector

Members:
Prof. DSc Dinko DINEV– Oak Forest Experimental Station, Burgas, Bulgaria
Prof. Dr. Ivan ILIEV – University of Forestry, Sofia, Bulgaria
Prof. DSc Atanas KOVACHEV– University of Forestry, Sofia, Bulgaria
Prof. Dr. Ivan PALIGOROV – University of Forestry, Sofia, Bulgaria
Prof. Dr. Rossitsa PETROVA – University of Forestry, Sofia, Bulgaria
Prof. Dr. Youlin TEPELIEV – University of Forestry, Sofia, Bulgaria
Prof. Dr. Rumen TOMOV – University of Forestry, Sofia, Bulgaria
Prof. DSc Hristo TSAKOV– Forest Research Institute, BAS, Sofia, Bulgaria
Prof. Dr. Stefan YURUKOV – University of Forestry, Sofia, Bulgaria
Dr. Neno ALEXANDROV – University of Forestry, Sofia, Bulgaria
Dr. Plamen ALEXANDROV – University of Forestry, Sofia, Bulgaria
Dr. Svetoslav ANEV – University of Forestry, Sofia, Bulgaria
Dr. Martin BORISOV – University of Forestry, Sofia, Bulgaria
Dr. Marius DIMITROV – University of Forestry, Sofia, Bulgaria
Dr. Emil GALEV – University of Forestry, Sofia, Bulgaria
Dr. Dimitar GEORGIEV – University of Forestry, Sofia, Bulgaria
Dr. Nasko ILIEV – University of Forestry, Sofia, Bulgaria
Dr. Georgi KOSTOV – University of Forestry, Sofia, Bulgaria
Dr. Kiril LYUBENOV – University of Forestry, Sofia, Bulgaria
Dr. Valentina MARINOVA – Ministry of Agriculture and Food, Sofia, Bulgaria
Dr. Hristo MIHAILOV – University of Forestry, Sofia, Bulgaria
Dr. Momchil PANAYOTOV – University of Forestry, Sofia, Bulgaria
Dr. Krasimira PETKOVA – University of Forestry, Sofia, Bulgaria
Dr. Elena RAFAILOVA – University of Forestry, Sofia, Bulgaria
Dr. Metodi SOTIROV – University of Freiburg, Germany
Dr. Toma TONCHEV – University of Forestry, Sofia, Bulgaria
Dr. Lyubcho TRICHKOV – Executive Forest Agency, Sofia, Bulgaria
Dr. Neno TRICHKOV – University of Forestry, Sofia, Bulgaria
Dr. Ivaylo VELICHKOV – Forest Research Institute, BAS, Sofia, Bulgaria
Dr. Tzvetan YORDANOV – University of Forestry, Sofia, Bulgaria
Dr. Chavdar ZHELEV – University of Forestry, Sofia, Bulgaria
Assist. Prof. Ing. Evgeni TSAVKOV – University of Forestry, Sofia, Bulgaria
Ing. Toni KRASTEV – Executive Forest Agency, Ministry of Agriculture and Food, Sofia, Bulgaria

Conference website: http://conf2015.forestry-ideas.info/

INTERNATIONAL SCIENTIFIC COMMITTEE

ORGANISING AND SUPPORTING INSTITUTIONS

University of Forestry, Sofia, Bulgaria

Faculty of Forestry, Sofia, Bulgaria

Ministry of Agriculture and Food of Bulgaria

Ministry of Education and Science of Bulgaria

Ministry of Environment and Water of Bulgaria

International Union of Forest Research Organizations

European Forest Institute

Union of European Foresters

Executive Forest Agency of Bulgaria

Union of Scientists in Bulgaria

Forest research Institute – BAS

HONORARY PRESIDENT
of the Conference
Desislava Taneva, Minister of Agriculture and Food of Bulgaria

The Conference will be held in parallel with the 7th annual meeting of the Deans and Directors of European Forestry Faculties and Schools (ConDDEFFS).

HONORARY PRESIDENT
of the 7th annual meeting of the ConDDEFFS
Prof. Todor Tanev, Minister of Education and Science of Bulgaria

Acknowledgments to our sponsors

LIST OF SPONSORS OF THE EVENTS MARKING THE 90TH ANNIVERSARY OF HIGHER FORESTRY EDUCATION IN BULGARIA

Ministry of Agriculture and Food of Bulgaria

Ministry of Education and Science of Bulgaria

Ministry of Environment and Water of Bulgaria

North Central State Forestry Enterprise – Gabrovo

Southwestern State Forestry Enterprise – Blagoevgrad

South Central State Forestry Enterprise – Smolyan

Southeastern State Forestry Enterprise – Sliven

Northwestern State Forestry Enterprise – Vratza

Northeastern State Forestry Enterprise – Shumen

Kronospan Bulgaria Ltd.

Andreas STIHL Ltd.

French Institute Sofia

America for Bulgaria Foundation

Husqvarna Bulgaria Ltd.

National Association of Hunters and Anglers
"Union of Hunters and Anglers in Bulgaria"

Kastamonu Bulgaria Co.

EcoInnovation Ltd.

Bulgarian Association of Ornamental Plants Nurseries

Florimex Ltd.

Byanovi Ltd.

Kozhuharov 2009 Ltd.

Nishava Ltd.

Home garden TT Ltd.

Kozarovi Ltd.

Bulland Trade Ltd.

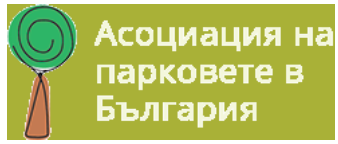
Professional Industry Organization
of Bulgarian Foresters – BULPROFOR

Labkonsult Ltd.

Vanko 97 Ltd.

Gora Invest AD

Mina Ltd.



Association of Parks in Bulgaria

Eledjik 99 EAD

JL Soft Ltd.

Union of Bulgarian Foresters

WWF in Bulgaria

Bulgarian Society for the Protection of Birds

Contents

AIM

The aim of the Conference is to bring together researchers from the very broad domain of forestry science in order to promote knowledge exchange and to strengthen the international scientific cooperation. The main focus of the Conference will be climate change and forest management. Participants are expected to share their experience in the field of sustainable forest management and its implementing for adapting the forest ecosystems to climate change. The Conference will provide opportunity to discuss all the issues related to climate change and its effect on forests: scientific, economical, and social aspects. However, besides its main focus the Conference offers opportunities for reporting and discussing on all topics related to forests and forestry.

MAIN TOPIC

Climate Change and Forests

Additional Topics:

Forest Biology and Ecology
Forest Operations and Wood Processing
Forest Management and Economics

POSTER SESSION I

Climate change, Forest ecology, and Biodiversity of forest ecosystems

POSTER SESSION II

Silviculture, Tree breeding and Afforestation, Forest protection, Forest and Landscape Management, Forest economics

PARTICIPANTS

Conference will be attended by 145 scientists and graduate students from 23 countries. Total 74 reports and 53 posters will be presented.

The papers presented oral or as poster at the Conference after undergoing a peer review will be published in the journal “Forestry Ideas”: http://forestry-ideas.info/

USEFUL INFORMATION

Talks

Oral Presentations

For each talk, there will be a 15 min time slot (10–12 min for the talk and 3–5 min for discussion). The chairs of each session will be asked to keep strict time management. We ask you to arrive on time in your session hall, in order to prevent delays.

Each conference hall is equipped with a Windows computer, a beamer and a laser pointer. We provide MS Office 2010. Please note that it will not be possible to use your own computer.

Please provide your presentation either as PowerPoint or PDF file on a USB memory stick.

The registration desk will open on Wednesday (May 6) 4 pm. Please hand over your presentation to the staff at the registration desk upon arrival. It will be possible to check the presentation on correct functioning and display of all slides. All presentations need to be handed over to the conference staff no later than the evening proceeding the day the talk is scheduled!

Posters

The posters will be on display from May 7 to May 8. All posters of both sessions should be mounted from 16:00 on May 6 to 9:00 on May 7. It is your responsibility to set-up your poster. Poster boards and appropriate pins for sticking the poster onto the board will be provided during the conference. The authors must be present at their posters during poster sessions. The number of the poster panel will be identical with the number in the Book of Abstracts (see in Content). The authors are kindly requested to mount their posters on the panel designated by the relevant number. At relevant session presenters are asked to stand by their poster/exhibition in order to discuss their research/design project with viewers. Posters will be displayed during the meeting and the poster sessions will be followed by discussion between authors and attendees.

Responsibility – Insurance

The Organizing Committee will not assume responsibility for any personal injury, damage or loss of property, which may happen in connection with the Conference. Participants should secure appropriate insurance coverage.

Publishing

The papers presented oral or as poster at the Conference will be published afterward in the journal "Forestry Ideas" after undergoing a peer review. Authors are requested to submit their manuscripts to the editors not later than December 31 2015 at the conference address forconf2015@abv.bg. Manuscripts should be submitted only in electronic version – both in Word.com and pdf format. Tables and figures should be sent as separate files in original format too (Excel for example). Their numbers must be indicated in the text. Please include color figures only it is necessary for readers to understand the information presented. Images for figures will be accepted only as TIF or JPEG format and minimum 300 dpi.

Requirements for the manuscripts
Word for Windows; Paper size – A4; Page Setup – Top: 2.5 cm, Bottom: 2.5 cm, Left: 2.5 cm, Right: 2.5 cm; Line spacing – 1.5 lines; Times New Roman, 12 points; First Line – by 1 cm; Title – Capital Letter, Center, Bold; Tables – Single Line Spacing, Size 10; Table's titles above and figure's titles below, centered, bold, size 11; The abbreviations in the tables and figures should be defined in the note below, centered, size 11.
For more details please see "Instructions to the authors" on the website of the journal (http://forestry-ideas.info/).
The following categories of manuscripts are distinguished:
• the regular manuscripts – up to 10 pages, including an abstract, tables, figures, illustrations, and references;
• the research notes – up to 8 manuscript pages, including an abstract, tables, figures, illustrations, and references.
The authors are asked to identify for themselves the type of the manuscript according to its characteristics. This will finally be determined by the editors and reviewers.

Additional requirements
• The body of the abstract should not exceed 350 words.
• Key words – up to 6, in alphabetical order, excluded those in the title.
• The text should be in clear and concise English. Please be consistent in punctuation, abbreviations and spelling.
• Use of standard abbreviations is desirable. Place special or unusual abbreviations in parentheses after the full term the first time it appears.
• The SI system should be used for all measurement units.
• Binomial Latin names should be used in accordance with the International Rules of Nomenclature. In the title after the Latin name of the species the name of its author should be included. Latin names should be typed in italics.
Two referees will review each manuscript. Papers will be printed free of charge in the journal "Forestry Ideas" in order of their successful reviewing.
The dead-line to send the manuscript is **31.12.2015**.

PROGRAM

May 06, 2015 – Wednesday (Arrival day)

16:00–19:00 Registration

20:00–22:00 Welcome Cocktail

May 07, 2015 – Thursday (1st day)

8:30–9:00 Welcome Coffee

Opening Ceremony

09:00–09:10 Welcome address by Prof. Veselin Brezin – Rector of the University of Forestry, Sofia.
09:10–09:20 Welcome address by the Ministry of Agriculture and Food and the Ministry of Education and Science of Bulgaria.
09:20–09:40 Guests welcome addresses.
09:40–10:00 "Forestry: Bridge to the Future" – presentation by Dr. Milko Milev – Dean of Faculty of Forestry, Sofia.

Plenary session – Hall Europa

Chair Person: Dr. Peter Zhelev (Bulgaria)

10:00–10:30 *Key lecture 1:* **Kevin L. O'Hara.** New directions in silviculture.

10:30–11:00 *Key lecture 2*: **Marcus Lindner.** What we (don't) know about climate change in European forests: bridging from science to practice.

11:00–11.30 Coffee break

11:30–12:00 *Key lecture 3*: **Jean-Luc Peyron.** Adaptation to and mitigation of climate change: two combined approaches in forestry.

12:00–12:30 *Key lecture 4*: **Ivan Raev.** Investigations of global climate change impacts on forest ecosystems in Bulgaria.

12:30–13:45 Lunch

Presentations by 5 sections (I–V): *A* in Hall Europa, *B* in Hall 5, and *C* in Hall 1. Section *C* (IV and V) only works on May 8 from 13:00 to 16:45.

Poster Sessions: two in Hotel Lobby.

May 07.2015 – Thursday (1st day) afternoon

Presentations by two sections: *A* in Hall Europa and *B* in Hall 5

Section* IA – *Hall Europa		***Section* IB – *Hall 5***
Chair Persons: Prof. Kulbhushan Balooni (India) and Dr. Daria K. Diyarova (Russia)		*Chair Persons:* Prof. Elizabet Vachkova (Bulgaria) and Dr. Ivo Valchev (Bulgaria)
Ned Nikolov and Karl Zeller. On the physical nature of the atmospheric greenhouse effect: a new perspective and its implications for understanding of future climate change.	13:45–14:00	**Ivan Paligorov**, **Emil Galev, Vasil Stiptzov, Stanislava Kovacheva, Elena Dragozova, and Ivaylo Ivanov**. The policy back-casting processes and analysis of implications of integrative and segregative management approaches to forest landscapes planning.
Victor A. Mukhin and Daria K. Diyarova. Wood-decaying fungi and the carbon cycle of forest ecosystems.	14:00–14:15	**Nikolay Neykov and Anna Dobritchova**. Optimization of financial resources in Bulgarian forestry after the reform in 2011.
Jürgen Müller. Investigation of the dry stress effect on the water consumption and the tree growth with the use of lysimeter.	14:1–14:30	**Lyubcho Trichkov and Vania Kachova.** Necessity, opportunities and priorities for development of agroforestry in Bulgaria.
Kulbhushan Balooni and Jens Friis Lund. Redd+ efforts through decentralized forestry: three challenges.	14:3–14:45	**Lyubcho Trichkov and Dinko Dinev.** Harvesting and processing of forest wood biomass in Bulgaria for energy purposes.
Lora Naydenova, Angel Ferezliev, and Miglena Zhiyanski. Carbon stocks in components of natural European beech ecosystems after thinning activities in Central Balkan.	14:4–15:00	**Dinko Dinev and Jelio Vardunski.** Testing and implementation of technologies into logging during a joint use of skidder, harvester and forwarder in Bulgaria.
Isabella De Meo, Martina Modotti, Alessandro Paletto, and Gianluca Grilli. Sustainability impact assessment (SIA) of renewable energy systems: overview of indicators and needs for future developments.	15:0–15:15	**Panayot Panayotov, Ivo Valchev, Kancho Kalmukov, Momchil Panayotov, Stoiko Petrin, and Nikolay Yavorov.** Black locust wood – perspective raw material for producing of chemical pulp and bioethanol.

15:15–16.00 Coffee break and **Poster Session I** in Hotel Lobby

16:45 – Departure to the "Bulgaria" Hall

18:00–20:00 Celebration ceremony of 90th Anniversary – Hall "Bulgaria"

20:15–20:30 Departure to the Park Hotel Moskva

May 08.2015 – Friday (2st day) in the morning

Presentations by two sections: *A* in Hall Europa and *B* in Hall 5

Section* IIA – *Hall Europa		***Section* IIB – *Hall 5***
Chair Persons: Prof. Nadka Ignatova (Bulgaria) and Prof. Wolfgang Beck (Germany)		*Chair Persons:* Dr. Bernd Stimm (Germany) and Dr. Federico Vessella (Italy)
Isabella De Meo, Paolo Cantiani, Claudia Becagli, Elisa Bianchetto, Cecilia Cazau, Stefano Mocali, and Elena Salerni. Thinnings to enhance biodiversity in Black pine stands: a case study in the Italian Apennine.	08:30–08:45	**Lyubka Varbeva and Nasko Iliev.** Seed qualities and seed dormancy breacking of Sycamore maple (*Acer pseudoplatanus* L.) seeds.
Puskar Khanal and Donald L. Grebner. Nonindustrial private forest (NIPF) landowners attitudes toward climate change and forest carbon sequestration in the Southern United States.	08:45–09:00	**Velika Jordanova and Konstantin Marinov.** Study of milling technology unit performance for site preparation of forest area for afforestation.
Wolfgang Beck and Tzvetan Zlatanov. Growth patterns and climate sensitive growth rates of Norway spruce, Silver fir and Black pine stands in the Western Rhodopes and in the Thuringian mountains, Germany.	09:00–09:15	**Elias Pipinis, Elias Milios, Miltiadis Georgiou, and Pavlos Smiris.** Effects of gibberellic acid and cold stratification on seed germination of two *Sorbus* species.
Tamara Eckhart, Marcela van Loo, and Hubert Hasenauer. Site conditions for growing Douglas-fir in Central Europe.	09:15–09:30	**Emil Popov.** Afforestations and nature conservation in Bulgaria.
Nadka Ignatova, Maria Mladenova, and Sonya Damyanova. Long-term development of throughfall deposition in a sensitive freshwater forested catchment.	09:30–09:45	**Federico Vessella, Erica Chiummariello, Francesco Angelini, Tatiana Marras, and Bartolomeo Schirone.** The emberger index and its application to forest restoration in the 21st century.
Katarzyna Dudek, Stanisław Małek, Józef Barszcz, Jacek Banach, Grzegorz Durlo, Krystyna Jagiełło-Leńczuk, and Mariusz Kormnanek. Changes in the content of carbon and nitrogen in the seedlings of European beech (*Fagus sylvatica* L.) and English oak (*Quercus robur* L.) during the growing season in 2014 in the container nursery.	09:45–10:00	**Michael Weber, Bernd Stimm, Patrick Hildebrandt, and Reinhard Mosandl**. Understanding of ecosystem functioning as a prerequisite for ecocompatible reforestation of degraded areas with native species – a case study from the Andean Ecuador.

10:00–10:45 Coffee break and **Poster Session II** in Hotel Lobby

May 08.2015 – Friday (2st day) before noon

Presentations by two sections: *A* in Hall Europa and *B* in Hall 5

Section* IIIA – *Hall Europa		***Section* IIIB – *Hall 5***
Chair Persons: Dr. Radim Matula (Czech Republic) and Dominik Thom (Austria)		*Chair Persons:* Prof. Tamara Sedelnikova (Russia) and Dr. Monika Konnert (Germany)
Radim Matula and Martin Šrámek. Resprouting ability and sprout growth dynamics in temperate trees after heavy disturbances.	10:45–11:00	**Martin Bachmann, Daniela Rommel, and Bernd Stimm.** Growth and regeneration of Macedonian pine (*Pinus peuce* Griseb.) in Bavaria against the backdrop of climate change.
Ibrahim Molla and EmiliyaVelizarova. Variation of the acid-base properties of forest soil and litter under different tree species affected by forest fires in South-eastern Bulgaria.	11:00–11:15	**Gerhard Huber, Krasimira Petkova, and Monika Konnert.** Comparative studies in Common beech provenances tests in Bavaria and Bulgaria.
Sizwe Mabaso, Peter Bunting, Andrew Hardy, Sandra Brown, Richard Lucas, Erik Naesset, Terje Gobakken, and Nuru Kaniki. Rapideye data for mapping and monitoring forest disturbance in Tanzania, Africa.	11:15–11:30	**Velichko Gagov, Petar Zhelev, and Ivan Evtimov.** Current status and perspectives of forest seed orchards in Bulgaria – look back and look forward.
Dominik Thom, Rupert Seidl, and Simon Thorn. Can disturbance management foster both biodiversity and ecosystem services?	11:30–11:45	**Alexander Tashev, Tamara Sedelnikova, and Alexander Pimenov.** Chromosome numbers and supernumerary (b) chromosomes in populations of Norway spruce from Western Rhodopes, Bulgaria.
Alexander Dountchev and Petar Zhelev. Natural and artificial regeneration of subalpine *Picea abies* (L.) Karst. forests after large-scale wind-disturbances in Vitosha Nature Park.	11:45–12:00	**Monika Konnert, Barbara Fussi, Hojka Kraigher, and Filipos Aravanopoulos.** Genetic monitoring in forests – efforts for a European implementation.
Zoran Stanivuković and Dane Marčeta. Consequences of *Ips typographus* attack on spruce forests in eastern part of the Republic of Srpska, Bosnia and Herzegovina.	12:00–12:15	**Radoslav Milchev and Maria Asenova.** Creating of geoportal server as a platform for research and training at the University of Forestry.

12:15–13:30 Lunch-break

May 08.2015 – Friday (2st day) afternoon

Presentations by three sections: *A* in Hall Europa, *B* in Hall 5, and *C* in Hall 1

Section* IVA – *Hall Europa		***Section* IVB – *Hall 5***		***Section* IVC – *Hall 1***
Chair Persons: Prof. Shyue-Cherng Liaw (Taiwan) and Dr. Elena Lapteva (Russia)		*Chair Persons:* Dr. Donald Hodges (USA) and Dr. Petros Tsioras (Greece)		*Chair Persons:* Prof. Sezgin Ayan (Turkey) and Prof. Vlatko Andonovski (Macedonia)
Peter Kitin, Edgard Espinoza, Hans Beeckman, and Pamela McClure. Wood identification of Fabaceae genera and species based on microstructure and dart-tofms.	13:30	**Janez Krč, Adriana Maria Nolasco, Adam Taylor, and Donald G. Hodges**. Assessing life cycle costs from wood energy for the EU.	13:30	**Marcin Pietrzykowski.** Forest ecosystem restoration on post mining sites – challenge of the new century.
Ivailo Nikolov and Marius Dimitrov. Syntaxonomic analysis of forest vegetation in Central Balkan National Park.	13:45	**Valentin S. Shalaev and Victor Teplyakov.** IUFRO history and Russia.	13:45	**Sezgin Ayan, Tuğba Dudu Günlü, and Aybaba Hançerlioğulları**. The effect of electromagnetic field applications on attributes of Anatolian Black pine seeds.
Elena M. Lapteva, Yulia A. Vinogradova, and Yury V. Kholopov. Structure and functional diversity of soil microbiota in north-taiga spruce forests of the European North-East.	14:00	**Donald G. Hodges.** Effect of carbon on optimal hardwood management regimes: an economic analysis.	14:00	**Zoran Govedar, Srđan Keren, and Drago Petković.** Natural regeneration in fire-affected pure stand of *Pinus nigra* Arn. in the area of Trebinje.
Elena M. Lapteva, Yulia Vinogradova, and Yury Kholopov. Activities of soil microbe communities at spruce forests clear-cuts of the European North-East.	14:15	**Petros A. Tsioras, Dionysios Bochtis, and George Banias.** GHG emissions in firewood supply chains: the case of Northern Greece.	14:15	**Nikolčo Velkovski, Jane Acevski, Vlatko Andonovski, Kole Vasilevski, Dejan Mandžukovski, and Goce Nikolovski.** Distribution, status and regenerating potential of Macedonian pine (*Pinus peuce* Griseb.) forests at the National Park Pelister.
Chun-Kuo Yeh and Shyue-Cherng Liaw. Landscape change trajectories of forested watershed under typhoon disturbances in Taiwan.	14:30	**Petros A. Tsioras, Diamantis Liamas, Pavlos Efthymiou, Dimitrios Koutsianitis, and Elias Voulgaridis.** Wooden pole production in Greece.	14:30	**Goce Nikolovski, Vojo Gogovski, Dejan Mandžukovski, Vlatko Andonovski, Jane Acevski, and Nikolčo Velkovski.** Analysis of the hunting grounds of Vlainsko-Maleshevska hunting management area in the Republic of Macedonia.
Dobrinka Zakova-Aleksandrova. Research of landscapes in landslides terrains in Melnik region using a long-distance method.	14:45	**Elias Milios, Kyriaki Kitikidou, Stelios Chatzakis, and Maria Batziou.** Structure analysis of a lowland *Quercus pubescens – Quercus frainetto* forest in Northeastern Greece.	14:45	**Fatemeh Hassanpour, Farid Kazem Nezhad, Bahram Naseri, Afsaneh Rezaei, Mehdi Kia Daliri, and Farshad Khodabakhsh Reshad**. Effects of different sowing treatments on Caucasian alder (*Alnus subcordata* C.A.Mey) seedling growth.

15:00–15:30 Coffee break

May 08.2015 – Friday (2st day) afternoon

Presentations by three sections: *A* in Hall Europa, *B* in Hall 5, and *C* in Hall 1

Section VA – Hall Europa		***Section VB – Hall 5***		***Section VC – Hall 1***
Chair Persons: Prof. Galina Kolganikhina (Russia) and Dr. Nikolay Zafirov (Bulgaria)		*Chair Persons:* Prof. Dmitry Schepaschenko (Russia) and Dr. Yavor Poryazov (Bulgaria)		*Chair Persons:* Dr. Wenhui Chen (China) and Dr. Stoyan Stoyanov (Bulgaria)
Evgenia Velinova, Yordanka Stancheva, and Alexander Tashev. Diseases in wild-growing Honey bearing plants in Lyulin Mountain in Bulgaria.	15:30	**Dmitry Schepaschenko, Myroslava Lesiv, Steffen Fritz, Linda See, Anatoly Shvidenko, Christoph Perger, Florian Kraxner, and Maria Schepaschenko**. Citizen science application for forestry.	15:30	**Emil Galev and Diana Koprinska**. Principles for the formation of spaces along walking trails in forest landscapes.
Ivaylo Tsvetkov, Stefan Mirchev, and Nikolay Zafirov. Climate-tree ring width relationship in a Cork oak (*Quercus suber* L.) stand in South-Eastern Bulgaria.	15:45-	**Myroslava Lesiv, Anatoly Shvidenko, Dmitry Schepaschenko, Linda See, and Steffen Fritz.** Development of a hybrid forest map using Ukraine as a case study.	15:45-	**Maria Gurkova.** Specific characteristics and some issues of protection of immovable cultural heritage objects in forest areas of Bulgaria.
Nikolay Zafirov, Stefan Mirtchev, and Radostina Schivacheva. Dendrochronological assessment of climatic and anthropogenic influences on urban forests in Bulgaria.	16:00	**Rumen Petrin**. Structure by height of natural Scots pine stands.	16:00	**Maria Gurkova and Emil Galev.** Principles of landscape architects in reporting immovable cultural heritage in forest areas.
Galina B. Kolganikhina. Mass dying of Colchis box in forests of Russian Caucasus.	16:15	**Toma Tonchev, Yavor Poryazov, and Violeta Dimitrova.** Aboveground biomass for Norway spruce stands in Western Balkan range.	16:15	**Evlogi Angelov, Gradimir Gruychev, and Stoyan Stoyanov**. Do hand Reared partridges (*Perdix perdix* L., 1758) survive after releasing in upland habitats of Western Bulgaria.
Aneta Lyubenova, Slavtcho Slavov, and Stefan Mirtchev. Risk analysis of potentially invasive pathogen *Phytophthora ramorum* for oak forests in Bulgaria based on climate data.	16:30	**Yavor Poryazov, Toma Tonchev, and Rilka Bekyarova.** Dynamic growth model for Red oak plantations in Bulgaria.	16:30	**Wenhui Chen and Junchang Liu.** The optimal management model for wild boar resources: case study with applications in Fujian and Heilongjiang provinces of China.

16:45–17:15 **General discussion – Hall Europa**

POSTERS

Two sessions at Hotel Lobby

May 07, 2015 – Thursday (1st day)

15:1500–16.00 Poster Session I with Coffee break

May 08, 2015 – Friday (2nd day)

10:00–10:45 Poster Session II with Coffee break

POSTER SESSION I

CLIMATE CHANGE, FOREST ECOLOGY, AND BIODIVERSITY OF FOREST ECOSYSTEMS

1. **Ned Nikolov and Karl Zeller.** On the physical nature of the atmospheric greenhouse effect: a new perspective and its implications for understanding of future climate change.
2. **Alexandra Alexandrova, Alexander Tashev, and Marius Dimitrov**. Floristic studies in Slivenska mountain (Eastern Stara Planina).
3. **Svetoslav Anev and Nikolina Tzvetkova**. Dynamics of gas-exchange within the crown of Norway spruce (*Picea abies* Karst.).
4. **Ina Aneva, Petar Zhelev, Stoyan Stoyanov, and Lyuba Evstatieva**. The plant communities of *Sideritis lanata* L. in South-western Bulgaria.
5. **Alexander Tashev, Maria Asenova, and Pavel Pavlov**. Distribution survey on *Tulipa urumoffii* Hayek across Chepan mountain (Western Balkan) and spatial data analysis in GIS environment.
6. **Maria Broshtilova and Kostadin Broshtilov**. Changes in the composition of the rainfall fluxes passed through the crowns of Black pine, Atlas cedar, Common oak and Black locust.
7. **Maria Broshtilova and Kostadin Broshtilov**. Dynamics of macroelements in the leaves of tree species growing in Pismenovo dendrarium.
8. **Georgi Hinkov, Emil Popov, and Georgi Erbakamov**. Assessing the conservation status of forest habitats in protected area 'Kamchiyska and Emenska mountain'.

9. **Adriana Ivanova, Svetoslav Anev, and Nikolina Tzvetkova**. Stomatal control on photosynthesis in dryed saplings of genus *Pinus*.
10. **Albena Ivanova, Anita Kostadinova, Momchil Panayotov, and Stefan Yorukov**. Xylogenesis of *Pinus heldreichii* H.Christ and *Pinus peuce* Griseb. in NP "Pirin".
11. **Mariangela N. Fotelli, Kyriaki Kitikidou, and Kalliopi Radoglou**. Foliar nitrogen content and nitrogen resorption efficiency across a gradient of European forests as affected by tree diversity and environmental drivers.
12. **Konstantinos Martinos, Elpiniki Skoufogianni, Alexandra Solomou, and Chrisi Stathaki.** Biodiversity conservation tactics and sustainable management of Greek forests: a review.
13. **Milan Medarević, Dragan Karadžić, Ljubodrag Mihajlović, Ivan Milenković, and Snežana Obradović**. Climatic changes and threatening factors of forest ecosystems in Serbia.
14. **Teodor Nedelin, Slavcho Savev, Kaloyan Kostov, and Melania Gyosheva**. New hypogeneous fungi for Bulgaria.
15. **Galina A. Novitskaya, A. A. Novitskaya, and S. A. Potapova**. *Tectona grandis* – past, present and future.
16. **Saša Pekeč, Saša Orlović, Andrej Pilipović, and Srđan Stojnić**. Physical properties of deposol and watering needs Pedunculate oak (*Quercus robur* L.) tree row seedlings.
17. **Andrej Pilipović, Saša Orlović, Zoran Galić, Milan Borišev, Milan Drekić, Miroslav Marković, and Leopold Poljaković-Pajnik**. Respiration of forest soils in different forest stands during dry and wet seasons.
18. **Maria Aslanidou, Athanasios Papaioannou, Elias Pipinis, Olga Mavrokordopoulou, Matina Katsanidou, and Pavlos Smiris**. Nutrients and heavy metals concentrations in needles of *Pinus brutia* Ten. in Thessaloniki, Greece.
19. **Anna Gavrilova, Boriana Sidjimova, Slavcho Savev, and Elena Topuzova**. Medicinal plants in Pirin National Park.
20. **Slavcho Savev, Ina Aneva, and Petar Zhelev**. Study on floristic composition and nature conservation status of plant communities of *Arctostaphylos uva-ursi* in Pirin National Park.
21. **Pepa Vasileva and Momchil Panayotov**. Dendrochronological reconstruction of fire history in *Pinus heldreichii* forests in Pirin Mountain.

22. **Milorad Veselinović, Suzana Mitrović, Dragica Vilotić, Nevena Cule, Dragana Dražić, Snežana Stajić, and Snežana Rajković**. Characteristics of a forest community at the locality 'Jozica koliba' in Serbia.
23. **Antonina Vitkova, Malina Delcheva, Alexander Tashev, Dimitar Dimitrov, Ina Aneva, and Anna Gavrilova**. Current state of populations and resource assessment of Alchemilla species in Western Stara Planina and Western Sredna Gora Mountains in Bulgaria.
24. **Vasily T. Yarmishko and Marina A. Yarmishko**. State of the forest communities in conditions of changing environment on European North of the Russia.
25. **Nikolay Yavorov, Ivo Valchev, and Stoyko Petrin**. Kinetic study of the enzymatic hydrolysis of *Robinia pseudoacacia* L. for bioethanol production.
26. **Hamana Malki and Dalila Kherchouche**. Drought reconstruction during the 5 last centuries for Aurès (North-eastern Algeria) from tree rings.
27. **Snezana Rajkovic, Miroslava Markovic, Ljubinko Rakonjac, Radoslav Rajkovic, Aleksandar Lucic, and Milorad Veselinovic**. Injury of ozone – monitoring plot – Mokra gora.

POSTER SESSION II

SILVICULTURE, TREE BREEDING AND AFFORESTATION, FOREST PROTECTION, FOREST AND LANDSCAPE MANAGEMENT, FOREST ECONOMICS

28. **Georgios Efthimiou**. The management of riparian forests in protected areas in Central Greece, the case of Sperheios and Pineios river.
29. **Alexandros-Michail Chatziminiadis, Kyriaki Kitikidou, and Elias Milios**. Volume tables for the European beech (*Fagus sylvatica* L.) of Kato Vermio of Imathia region, Northern Greece.
30. **Dobrinka Zakova-Aleksandrova**. Comparative study of the growth of *Pinus nigra* and *Cedrus atlantica* in Melnik region.
31. **Danail Takov, Danail Doychev, Daniela Pilarska, and Slavimira Draganova.** Natural pathogens on two forest insects in Bulgaria.
32. **Fotios Maris and Kyriaki Kitikidou**. Use of log dams for erosion control – assessment considerations.

33. **Miroslava Markovic, Mara Tabakovic-Tosic, Snezana Rajkovic, and Ljubinko Rakonjac.** Epiphytotic of powdery mildew in South-eastern Serbia.
34. **Vesna Golubović Ćurguz, Dragan Karadžić, Ivan Milenković, Katarzyna Sikora, and Zlatan Radulović**. Identification and pathogenicity of the most important tracheomycotic fungi on *Quercus petraea* (Matt.) Liebl. in Serbia.
35. **Zlatan Radulović, Dragan Karadžić, Vesna Golubović Ćurguz, and Ivan Milenković.** The most common fungi and pseudofungi on Sweet chestnut (*Castanea sativa* Mill.) in Central Serbia.
36. **Ioannis Mitsopoulos, Yannis Raftoyannis, and Dimitrios Bakaloudis**. Forest experts perceptions on fire management in fir forests of Greece under a changing climate.
37. **Konstantinos S. Tsiolis and Georgios S. Efthimiou.** Forest fire protection infrastructures in natural protected areas with management body. An existing survey of Greece.
38. **Momchil Panayotov, Evgeni Tsavkov, Georgi Gogushev, and Peter Bebi**. Large-scale natural disturbances in Bulgaria – a historical overview.
39. **Aneliya Pencheva and Mariya Yovkova**. New data about alien insect pests on ornamental plants in Bulgaria.
40. **Mara Tabakovic-Tosic, Miroslava Markovic, and Marija Milosavljevic**. Gypsy moth outbreaks in forest complexes of the Jablanica region (Southern Serbia) in the period 1996–2014.
41. **Nickolay Tsvetanov, Alexander Dountchev, Momchil Panayotov, and Stefan Yurukov**. The effects of micro-relief forms on natural regeneration after windthrows in Bulgaria.
42. **Konstantinos Koukoulomatis and Ioannis Mitsopoulos.** Assessing the effect of fuel treatments on fire behavior in Black pine (*Pinus nigra* Arn.) plantations in Southern Bulgaria.
43. **Milko Milev and Alexander Bardarov**. Assessment of some sustainability indicators for Black pine (*Pinus nigra* Arn.) provenance trials in Petrohan training and experimental forest range, North-West Bulgaria.
44. **Aneliya Dimitrova, Kancho Kalmukov, Ilka Yonovska, and Miroslav Mikov.** Shoot regeneration ability of willow clones in biomass plantations.
45. **Krasimira Petkova, Yavor Poryazov, and Raisa Petrova**. Growth and state of Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) in the region of Yundola training and experimental forest range.

46. **Ispikoudis Stefanos, Elias Pipinis, and Pavlos Smiris.** Effects of collection season and k-iba application on rooting of *Olea europaea* var. *oleaster* stem cuttings.
47. **Sonia Smirnakou and Kalliopi Radoglou**. Enhanced growth characteristics of *Castanea sativa* Mill. seedlings exposed to led lights with continuous spectrum during indoor cultivation.
48. **Yordanka Stancheva, Krasimira Petkova, and Sonya Bencheva**. Agroforestry: a secure future for global crop production.
49. **Uladzimir Torchyk and Gennady Kholopuk**. Phenotypic variability of Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) during introduction in Belarus.
50. **Rossitsa Petrova, Atanas Kovachev, and Svetlana Anisimova**. Reclamation, landscape design and recreational opportunities of quarries.
51. **Shyue-Cherng Liaw and Jia-En Sheu**. Public awareness and satisfaction toward recreational trails in urban forest, Taiwan.
52. **Veselin Shahanov**. Conception for typology of composition in landscape architecture.
53. **Caihong Zhang, Liangzhen Zang, and Lan Zhang**. Research on spatial distribution of under-forest economic development in China.

19:00	Departure to the restaurant "Chevermeto"
19:30–23:00	Folk-style dinner

May 9, 2015 – Saturday (3rd day)

8:30–19:00 One-day field trip to Yundola Training and Experimental Forest Range

May 10, 2015 – Sunday (Departure day)

INVITED LECTURES

NEW DIRECTIONS IN SILVICULTURE

Kevin L. O'Hara

University of California, Berkeley, CA 94720-3114, USA.
E-mail: kohara@berkeley.edu

Silviculture, as the means by which nearly all forest management is implemented, faces many new challenges as we move forward. On one hand, there is the ever-present need for more wood products that drives intensive plantation management. These plantations are generally highly productive and offset the need for intensive management for wood products on other lands where environmental concerns may dominate or where other objectives may be pursued. On the other hand, the majority of forest lands will be managed to provide a more varied array of goods and services. These forests will often be managed as mixed-species or multiaged forests where species and stand structural diversity are encouraged. Foresters will integrate existing stand structural features into prescriptions resulting in every stand being unique in its structure and its management. The managers of these forests will need to integrate information on changing climate and responses of trees to these changes in order to introduce new species or provenances of existing species that are more adapted to anticipated future conditions. Age classes and species of these forests will exist in mixtures of overlapping generations that will form stand structures that will be more complex than present forests due to their more variable genetic make-up. These trends will result in a greater divergence in the management of plantation and complex forests. These complex forests will not necessarily be managed to maximize complexity, although that may be true in some cases. Instead the adaptations in management will result in structures that have a higher level of genetic complexity than forests of the past. Whereas plantation silviculture will continue to be a highly quantitative, "precision" approach to management, the complex forests will be managed using climate forecast models to broadly prescribe management direction. The specific details of individual stand management will be at the discretion of the forester. The future of silviculture of stands managed for complexity and adaptedness will be highly specific to local site conditions and require foresters that understand both the implications of global change and the specific characteristics of the sites they manage.

Key words: climate change, ecosystem services, mixed-species, multiaged, silviculture prescriptions.

WHAT WE (DON'T) KNOW ABOUT CLIMATE CHANGE IN EUROPEAN FORESTS: BRIDGING FROM SCIENCE TO PRACTICE

Marcus Lindner

European Forest Institute, Yliopistokatu 6, 80100 Joensuu, Finland.
E-mail: marcus.lindner@efi.int

The knowledge about potential climate change impacts on forests is continuously expanding. This presentation summarizes the scientific knowledge on climate change impacts on European forests. Changes in forest growth, increased drought induced mortality and shifting species distributions have already been observed. However, simulation studies projecting future climate change impacts have often resulted in conflicting evidence. Despite a significant body of research, a knowledge and communication gap exists between scientists and non-scientists as to how climate change impact scenarios can be interpreted and what they imply for European forests. It is still challenging to advise forest decision makers on how best to plan for climate change as many uncertainties and unknowns remain and it is difficult to communicate these to practitioners and other decision makers while retaining emphasis on the importance of planning for adaptation.

Recent evidence on climate change and both observed and projected impacts on European forests are reviewed and the associated uncertainties are discussed. Current impact assessments with simulation models contain several simplifications, which explain the discrepancy between results of many simulation studies and the rapidly increasing body of evidence about already observed changes in forest productivity and species distribution. Individual climate change impact studies should not be uncritically used for decision-making without reflection on possible shortcomings in system understanding, model accuracy and other assumptions made. It is important for decision makers in forest management to realise that they have to take long lasting management decisions while uncertainty about climate change impacts are still large. Communicating scientific understanding to practice requires explaining uncertainties in simple terms without diluting the overall message. Adaptive forest management to respond to the challenges of climate change depends on improved systems understanding. This needs to be translated into expert knowledge to offer science-based decision support to local practitioners.

Key words: adaptive forest management, climate change impacts, decision making, science-practice interface.

ADAPTATION TO AND MITIGATION OF CLIMATE CHANGE: TWO COMBINED APPROACHES IN FORESTRY

Jean-Luc Peyron

Ecofor, 42 rue Scheffer, 75.116, Paris, France.
E-mail: jean-luc.peyron@gip-ecofor.org

Forests are able to mitigate climate change mainly through carbon sequestration, storage, and substitution. But these different options are generally conflicting. How should they be combined? This question is a first major challenge for forest management and policy. In parallel, forests are impacted by climate change through trends (beneficial or detrimental) and extreme events. They may adapt and deserve to be adapted to these gradual or brutal phenomena. Integration of trends and extreme events is a second major challenge for forestry. Adaptation and mitigation have to be distinguished because they are very different responses to climate change. In the same time, they are interrelated since mitigation supports carbon regulation as an ecosystem service influenced by forest adaptation. Moreover, each forest measure can be evaluated from both adaptation and mitigation viewpoints. Consequently, synergies and trade-offs between forest adaptation and mitigation are a third challenge. Finally, climate change issues are only a part of sustainable forest management and trade-offs also exist between climate change measures and sustainability at large.

These issues will be discussed at the stand level where economic models dealing with climate change impacts (trends and extreme events), adaptation measures and mitigation options can be combined in order to identify a desirable silviculture (rotation age). They will also be discussed at the national scale where the carbon balance of forests should be projected over the 21st century according to scenarios combining various harvest options with different climate change intensities.

In a field where one option is often promoted against all others, the results will show that forest management should use all options in order to improve the forest carbon balance while preventing future risks, and to take into account short term aspects as well as long term considerations.

Key words: carbon balance, economics, rotation age, sustainable forest management, temporal dimension, trade-offs.

INVESTIGATIONS OF GLOBAL CLIMATE CHANGE IMPACTS ON FOREST ECOSYSTEMS IN BULGARIA

Ivan Raev

Forest Research Institute, Bulgarian Academy of Sciences, Sofia, Bulgaria. E-mail: ivan_raev@yahoo.com

The studies on the effect of global climate change on the forests in Bulgaria started after the Conference in Rio (1992). The first climate scenarios were developed, life zones were delineated and the accumulation of CO_2 in the annual increment of the forests in the country was calculated (1996). International conference on the global climate changes took place in Bulgaria in 1997 and National Coordination Center for Global Change was established within the Bulgarian Academy of Sciences. The results of a research project finalized in 2003 showed that the drought of 1982–1994 should be considered a contemporary analog for climate change in Bulgaria. The natural, economic and social aspects of drought, including in the forests, were analyzed. The „Programme of Measures for Adaptation of the Forests in the Republic of Bulgaria and Mitigation the Negative Effect of Climate Change on Them" was finalized in 2011. The status of forests was analyzed and climatic scenarios were developed for 20th and 21st century. The „vulnerability zones" in the forests under climate change were delineated and a programme of measures for their adaptation to changing climate was developed. The Programme was approved by the state authorities and is implemented by the Executive Forest Agency. The project „Climatic Changes and their Influence on the Forest Ecosstems and Water Resources in the Struma River Basin" (2012) provided instructions for adaptation of forests in the region to particular ecological conditions. Also, a demonstration project was developed for Panagyurishte regional forestry service, including prognoses of temperatures, rainfalls and expected responses by the tree species to climate change (2013). The project „Assessment of Drought Impact on Forests Ecosystems" (2015) used the scenarios of IPCC AR5 (2014). The areas and growing stock were calculated for different vulnerability zones using GIS methods at stand levelfor the whole country. The projected dynamics of the main tree species was analyzed. Results of the studies on the effect of global climate change on the forests in Bulgaria during the period 1993–2015 were used in the National Communications on Climate Change for Republic of Bulgaria (1996, 1998, 2002), and also in the National Action Plans on Climate Change (2000, 2005). The results and conclusions were used in the „Classification scheme of the forest site types in Bulgaria" (2011) and in the „National Strategy for Development of the Forest Sector 2013–2020". All results of the research performed were used by the state authorities of Bulgaria.

Key words: adaptation measures, climate change scenarios, drought, National strategy, research and development projects, vulnerability zones.

ORAL PRESENTATIONS

DISTRIBUTION, STATUS AND REGENERATING POTENTIAL OF MACEDONIAN PINE (*PINUS PEUCE* GRISEB.) FORESTS AT THE NATIONAL PARK PELISTER

Nikolčo Velkovski[1*], Jane Acevski[1], Vlatko Andonovski[1], Kole Vasilevski[1], Dejan Mandžukovski[2], and Goce Nikolovski[2]

[1]Faculty of Forestry, Ss. Cyril and Methodius University in Skopje, 1 Makedonska brigada 16 str., P.O. Box 235, MK-1000 Skopje, Republic of Macedonia.
[*]E-mail: nvelkovski@sf.ukim.edu.mk
[2]Public Enterprise "Makedonski sumi", 128 Pero Nakov str., MK-1000 Skopje, Republic of Macedonia.

In the forests of the Macedonian pine at the National Park Pelister there are evident dynamic changes in terms of their distribution, condition and regeneration. Since the time of its determination in 1839 by Grisebach at the locality Begova Chesma till today the Macedonian pine forests are influenced by the changes of natural conditions and bioecological characteristics of this pine and other species that are naturally present in the area. According to recent scientific research for the period 1839–2014 it shows a continuous extension of the Macedonian pine in the National Park Pelister. This extension is going ahead along the non-forested areas in elevation over 2400 m, and goes down under 900 m altitude. It shows properties of species with strong regeneration potentials which are obvious and expand its distribution in the non-forested areas, such as pastures, shrubberies, rocky areas and similar primary sites. But on the secondary sites especially in old forests of Macedonian pine its regeneration potential is not that expressed, and they have seen the gradual penetration of beech and fir species. Given that the Macedonian pine as Balkan endemic and tertiary relic tree species has a special meaning for the forest diversity and is a special symbol of the National Park Pelister, the research on regeneration and succession processes are of great importance for the preservation of their natural values and their lasting sustainable development.

Key words: bioecological characteristics, condition, dynamic changes, endemic, regeneration potential, succession processes.

DO HAND REARED PARTRIDGES (*PERDIX PERDIX* L., 1758) SURVIVE AFTER RELEASING IN UPLAND HABITATS OF WESTERN BULGARIA

Evlogi Angelov*, Gradimir Gruychev, and Stoyan Stoyanov

Deptement of Wildlife Management, University of Forestry, 10 St. Kl. Ohridski blvd., 1797 Sofia, Bulgaria. *E-mail: evoangelov@gmail.com

Releasing of hand-reared game birds is a powerful tool to increase the population size of wild birds and to lower hunting pressure on their natural populations. Survival and adaptation in the wild of the farm game birds are crucial for assessing game farming efficiency. Survival rate of 33 grey partridges released in the autumn from cages in the harsh environment of Mala Mountain uplands (850 m a.s.l.) was estimated by applying radio-telemetry. The study area was covered mainly by hay fields and pastures, while arable land was below 10 % of the territory. The birds stayed within an area of 70 ha (100 % maximum convex polygon) with dispersion below 770 m from releasing points. A very few birds dispersed in such long distances, while most of them stayed close to the cages. After releasing partridges showed preferences to scrub near hay fields. The highest mortality rates occurred in the first week when almost 80 % of birds died, and only one bird survived more than 2 weeks. The main factor for mortality was predation by red fox (66.7 % of birds). Synthesis and application: Gray partridge population size in harsh environments could not be increased by releasing of farm birds using traditional methods. Still the use of farm produced birds is reliable way for wild bird populations' recovery, but the correct methods and high quality farm birds have to be used. Habitat quality also plays an important role in the survival of released birds and their interactions with wild populations.

Key words: farm birds, grey partridge, home range, radio telemetry, survival rates.

RURAL PARTICIPATION FOR FOREST SUSTAINABLE DEVELOPMENT IN CENTRAL PARTS OF IRAN

Rokhsareh Armoon[1*], Seyed Mohammad Hosseini[2], and Alois Skoupy[2]

[1]Science and Research Branch, Faculty of Humanities, Ismalic Azad University, Bolvar e Hesarak, P.O.Box: 775/14515, Tehran, Iran. E-mail: rchoob@yahoo.com*
[2]Faculty of Forestry and wood Sciences, Czech University of Life Sciences, Kamýcká 176, Prague, CZ - 165 21, Czech Republic. E-mails: s_hosseini99@yahoo.com; skoupy@fld.czu.cz

In semiarid environments, availability of water and nutrients are the main factors limiting the success of afforestation. For many reasons as social-economic, ecologic and economic situations, encouraging of rural people for participation of afforestation and green space activities in semiarid regions are quite difficult. Afforesting with trees in the semiarid climatic conditions of the central part of Iran into account and also regarding the importance as well as the enormous costs of irrigation of planting and development of green spaces in such a region. In order to evaluating of rural participations for afforestation activities, 50 rural dwellers were selected by randomly and been asked them to fill the questionnaire forms and answer 10 important questions about forest development. The research was carried out in the village known as Foladmahalleh which is located near the central desert of Iran. Rural viewpoints have been evaluated 3 times during the spring, summer and autumn same time as new afforestation technique were introduced by using of super absorbent. The results indicate that there are statistically differences in the beginning and the end of plantation especially on point of views about faith to immigration and readiness to cooperation. The rural participation and their point of views on afforestation and their attention to the new afforestation will be discussed in details in this paper.

Key words: afforestation, arid climate, ecosystem management, irrigation, plantations.

THE EFFECT OF ELECTROMAGNETIC FIELD APPLICATIONS ON ATTRIBUTES OF ANATOLIAN BLACK PINE SEEDS

Sezgin Ayan[1*], Tuğba Dudu Günlü[2], and Aybaba Hançerlioğulları[3]

[1]Department of Silviculture, Faculty of Foresrtry, Kastamonu University, 37100 Kuzeykent, Kastamonu, Turkey. E-mail: sezginayan@gmail.com
[2]Graduate School of Natural and Applied Sciences, Kastamonu University, 37100 Kuzeykent, Kastamonu, Turkey.
[3]Department of Physics, Faculty of Art and Sciences, Kastamonu University, 37100 Kuzeykent, Kastamonu, Turkey.

The effects of electromagnetic field applications on plant growth and development are still unclear and contradictory. So, in this study, the effects of electromagnetic field treatments on seeds of Anatolian Black Pine (*Pinus nigra* Arn. var. *caramanica* (Loudon) Rehder) were investigated. Two independent experiments were conducted for this purpose. They were carried out in the Laboratory of Silviculture Department, Faculty of Forestry, Kastamonu University. I experiment: Dry and water-swollen seeds for 12 hours were used. Seeds, was subjected to different magnetic field intensities (10-25-50-100 and 200 mT) for 5-10-15-30-60 and 90 minutes. According to the results of this experiments, short term (5 min) and high magnetic field intensity (200 mT) exposed to the water-swollen seed germination percentage was higher than the other treatments. II experiment: The seeds, water-swollen for 12 hours, were exposed to the magnetic field applications. In this experiment, the seeds were exposed to different time intervals 5 min, 10 min and 15 min and different magnetic field intensities 150 mT, 300 mT and 450 mT, respectively. The control and experimental groups were germinated at optimum conditions in the climate chamber. Germination percentage was measured at 4^{th}, 7^{th}, 14^{th}, 21^{st} and 27^{th} days. The germination rate of seeds and germination percentage was measured at 10^{th} and 27^{th}, respectively. The data obtained from the percentage and rate of seeds germination with the different magnetic field intensities and different time intervals variance analysis was performed with SPSS statistical software. As a result, the germination percentages and rates were higher in the magnetic field applications than that in the control group. Duncan test was applied in order to manifest the obtained differences. According this, generally, the best germination rate and percentage in magnetic field intensity which was applied for 450 mT and 5 min was obtained.

Key words: exposure time, intensity, magnetic field, *Pinus nigra* var. *caramanica*, vitality.

REDD+ EFFORTS THROUGH DECENTRALIZED FORESTRY: THREE CHALLENGES

Kulbhushan Balooni[1*] and Jens Friis Lund[2]

[1]Indian Institute of Management Kozhikode, IIMK Campus PO, Kozhikode, 673570, India.
[*]E-mail: kbalooni@yahoo.com
[2]Section for Global Development, Department of Food and Resource Economics, Faculty of Science, University of Copenhagen, Bülowsvej 17, 1870 Frederiksberg C, Denmark.

In developing countries with existing decentralized forest management policies, the introduction of reducing emissions from deforestation and forest degradation plus (REDD+) has implied a focus on incentivizing further conservation of forests under decentralized management. This is reflected in, among other, the REDD+ policies and pilot projects in a reasonably good number of developing countries. Yet, this specific focus, as it appears currently, has challenges. This paper highlights that the implementation of REDD+ to incentivize conservation of forests managed by communities under decentralized forest management is a challenging road to REDD+ because of three general characteristics of forests under existing decentralized management regimes. First, these forests already accumulate biomass and, in some cases, generate leakage, which threatens to undercut REDD+ additionality. Second, these forests are many and small, which will drive up REDD+ transactions costs. Third, beyond the "conservation islands" represented by forests under decentralized management, processes of deforestation and forest degradation continue. Given these challenges, this paper highlights that REDD+ efforts through decentralized forestry should be redirected from incentivizing further conservation of forests under existing decentralized management arrangements toward a push for extending the coverage of forests under decentralized management, and making forest rights the hard currency of REDD+. The international donor community, NGOs, researchers, communities, governments, and other actors with an interest in REDD+ should use the current momentum and financial muscle to push forward such implementation.

Key words: additionality; conservation; decentralized forest management; forest rights, forest tenure; leakage.

GROWTH PATTERNS AND CLIMATE SENSITIVE GROWTH RATES OF NORWAY SPRUCE, SILVER FIR AND BLACK PINE STANDS IN THE WESTERN RHODOPES AND IN THE THURINGIAN MOUNTAINS, GERMANY

Wolfgang Beck[1*] and Tzvetan Zlatanov[2]

[1]Thünen Institute for Forest Ecosystems, Alfred-Moeller-Strasse 1, Eberswalde, 16225, Germany. [*]E-mail: wolfgang.beck@ti.bund.de
[2]Forest Research Institute, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria.

Using dendroecological methods this study compares the growth responses of Norway spruce (*Picea abies* (L.) Karst.), Silver fir (*Abies alba* Mill.), and Black pine (*Pinus nigra* Arn.) forests in Thuringia (Germany), and the Rhodopes (Bulgaria). The study highlights reactions to former atmospheric deposition and recent climatic changes, between the species and across a large geographic and climatic gradient. All three species are native in Bulgaria, whereas Black pine has been introduced to Germany, cultivated mainly at dry limestone sites. In Germany, two Norway spruce, four Silver fir, and four Black pine stands were sampled. In the Western Rhodopes, two Silver fir, four Black pine, and four Norway spruce stands form the data base. Tree ring series from 20 dominant trees were used from each site and species to derive the mean, stand-typical growth pattern, which is explained by the mean courses of radial increment, diameter, basal area, and basal area increment. The most conspicuous result was found for Silver fir stands in Germany, showing a very similar growth pattern. The firs heavily suffered from air pollutants during the 1970s and 1980s and show now, beginning with the 1990s, hypertrophic growth rates; comparable only with these, known from Douglas fir. Under conditions of warming, this species is able to continue its growth upwards trend. Most interesting results come from Bulgarian Black pine forests. At the sample site (region of Solishta) two neighbouring stands of different age (300 vs. 90 years) were sampled. Both stands show in the main an undisturbed, homogeneous growth pattern. So, the Solishta data can serve as a valuable reference for German stands. Calculations of resilience values showed, that after the extreme drought year 2003 in Germany, the Silver fir stands were considerably more resilient than these of Norway spruce and Black pine. The Bulgarian Black pine stands did not show a well-expressed response after drought years, probably due to good adaptation. Analyses of climate-growth reactions of Black pine stands led to the results that German stands depend most strongly to precipitation from May to July and on the late summer temperature of the previous year. The growth rates of the Bulgarian Black pine stands depend mainly on precipitation during spring and also on previous late summer temperature.

Key words: climate effects, resilience, adaptation, tree species comparison.

THE OPTIMAL MANAGEMENT MODEL FOR WILD BOAR RESOURCES: CASE STUDY WITH APPLICATIONS IN FUJIAN AND HEILONGJIANG PROVINCES OF CHINA

Wenhui Chen* **and Junchang Liu**

School of Economics & Management, Beijing Forestry University, 100083 Beijing, China.
*E-mails: wenhui@bjfu.edu.cn, chenwenhui77@163.com

The population increase of wild boar (*Sus scrofa* L.) poses new problems to forest resource protection and to wild boar resource management. A crucial problem is how to balance between ecosystem conservation and human living, production and property safety. We used systematically logistic model to analyze the relationship between changes in population size and economic development by choosing wild boar as the research object. The dynamic economic equilibrium model about wild boar resource could be developed with applying analysis of cost-benefit. The main theoretic conclusions of the analysis were as follow: 1) there is an existing equilibrium about wild boar resource optimal management; 2) the optimal population size and yield were controlled by carrying capacity of the environment, by the increase of cure rate of wild boar resource and the society discount rate; 3) they only affect the track to the optimal conditions on the investment rate, the tax rate and the subsidy rate about wild boar utilization industry. Last, we selected the wild boar resource management in the Fujian province and Heilongjiang province of China as case to develop the applied model. The optimal population size was estimated 154.5 thousands and the optimal harvest was 20.8 thousands in Fujian province. In Heilongjiang province the optimal population size was 60.8 thousands and the optimal harvest was 4.4 thousands. Discount rate change also affects the optimal wild boar population size and harvest. These results provide the basis of controlling wild boar populations and developing policies for wild boar management.

Key words: dynamic economic model, population size, sustainable management and conservation, sustainable yield.

THINNINGS TO ENHANCE BIODIVERSITY IN BLACK PINE STANDS: A CASE STUDY IN THE ITALIAN APENNINE

Isabella De Meo[1*], Paolo Cantiani[2], Claudia Becagli[2], Elisa Bianchetto[1], Cecilia Cazau[2], Stefano Mocali[1], and Elena Salerni[3]

[1]Consiglio per la Ricerca in Agricoltura e l'analisi dell'economia agraria – Agrobiology and Pedology Centre (CRA-ABP), P.za D'Azeglio 30, 50121 Firenze, Italy.
[*]E-mail: isabella.demeo@entecra.it
[2]Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria – Research Centre for Forest Ecology and Silviculture (CRA-SEL), Via S. Margherita 80, 52100 Arezzo, Italy.
[3]Dipartimento di Scienze della Vita- Università degli Studi di Siena, Via P.A. Mattioli 4, 53100 Siena, Italy.

One of the main consequence of intensive forest exploitation, overgrazing and continual wildfires over the centuries is the decay of forest cover and soil erosion. In various areas of the Italian Apennines, Black pine plantations were established after the Second World War to improve forest soil quality in marginal and eroded soils. The main aim of these reforestations was to re-establish the pine as a first cover, pioneer species. This was a preparatory step to the reintroduction of broadleaf trees originally living in the same areas, such as oaks and beech trees, and thus to the reestablishment of mixed forests (renaturalisation). Today in Italy, Black pine and calabrian pine forests cover nearly 236,467 ha (23 % of the total area covered by conifers). In Tuscany, these stands cover nearly 20,500 ha and already achieved the land restoration purpose. Currently the key functions are the protection against soil erosion and the hydrological regulation of catchments. In order to guarantee the multifunctional and sustainable role of these stands, it is necessary to establish and realize silvicultural treatments finalized to the renaturalisation. The first stages of management of Black pine plantations are founded on thinnings, which are primarily aimed at regulating stand structure. Intensity of thinning has different effects on pine stands growth (economic function) and physical stability of trees (protective function). Moreover techniques and intensity of thinnings influence the level of biodiversity in Black pine stands undergrowth and soil components (flora, fungi, bacteria, mesofauna, nematodes and microarthropods). The present research aims to evaluate the effects of different thinning intensity on floristic and mycological diversity. The study was carried out in a mountainous area in Tuscany, in the Province of Arezzo (Pratomagno), which is representative of typical forested areas in northern and central Apennines. 20 experimental plots (300 m^2 to 364 m^2) were realized, and different intensity of thinning were applied. Results highlight that the intensity of thinning is directly related to the stability of the stands and also increases the overall biodiversity.

In particular positive effects are evidenced on marketable mushrooms production and on floristic diversity.

Key words: floristic diversity, mycological diversity, pine plantations, renaturalisation, silvicultural treatments, Tuscany.

SUSTAINABILITY IMPACT ASSESSMENT (SIA) OF RENEWABLE ENERGY SYSTEMS: OVERVIEW OF INDICATORS AND NEEDS FOR FUTURE DEVELOPMENTS

Isabella De Meo[1*], Martina Modotti[1], Alessandro Paletto[2], and Gianluca Grilli[3]

[1]Consiglio per la Ricerca in Agricoltura e l'analisi dell'economia agraria – Agrobiology and Pedology Centre (CRA-ABP), P.za D'Azeglio 30, 50121 Firenze, Italy.
[*]E-mail: isabella.demeo@entecra.it
[2]Consiglio per la Ricerca in Agricoltura e l'analisi dell'economia agraria – Forest Monitoring and Management Research Unit (CRA-MPF), P.za Nicolini 6, 38100 Villazzano, Trento, Italy.
[3]Eurac Research – Institute of Renewable Energy, Drususallee 1, 39100 Bolzano, Italy.

In the last decades, the international energy-demand has risen greatly due to the world's population growth and the economic development of some big countries (e.g. China, India, Indonesia). The intensive use of fossil fuels is recognized as unsustainable in the long-term period. In this framework, renewable energies represent important sources in order to satisfy the energy-demand in a sustainable way. European Union (EU) promotes the use of renewable energy sources (RES) to reduce greenhouse gas (GHG) emissions, to increase energy independence and to promote the renewable industry. Renewable energy policy must take into account the technical aspects of energy production and also the environmental, economic and social aspects, following an integrated approach. Consequently, sustainability assessment has become a fast developing research field and impact assessment tools – based on methods that take in consideration stakeholders' opinions and expectations – are commonly used to support policies or projects implementation. Sustainability Impact Assessment (SIA) is a tool that supports decision-makers in identifying potential impacts of possible policy actions. Environmental, economic and social aspects related to renewable energies are often analysed with sectorial approaches. To overcome this gap, it is fundamental to develop practical instruments useful for an integrated assessment considering environmental, technical-logistics, financial and social parameters of renewable energy systems. Starting from these considerations, this research investigates the indicators useful to support the SIA of a policy, a plan or a single action related to a renewable energy system. Social and economic dimensions and related indicators are analyzed, also including indicators which straddle between socio-economic and environmental sector. A comprehensive

in-depth literature review has been made in order to create a database of criteria and indicators. After creating the database, authors selected 308 suitable indicators: 93 relating to the economic dimension, 152 to the socio-political and cultural one and 63 to the social-environmental dimension. Furthermore, indicators were aggregated into three main impact dimensions (economic, social-political and social-environmental) and six general criteria. Finally, some recommendations are given to contribute at developing new indicators for the assessment of effects of renewable energy systems on sustainability.

Key words: energy-demand, impact dimensions, socio-economic indicators, sustainable development.

HARVESTING AND PROCESSING OF FOREST WOOD BIOMASS IN BULGARIA FOR ENERGY PURPOSES

Lyubcho Trichkov[1*] and Dinko Dinev[2]

[1]Executive Forest Agency, 55 Hristo Botev blvd., 1040 Sofia, Bulgaria.
[*]E-mail: lptrichkov@iag.bg
[2]Oak Forest Experimental Station, Izgrev Complex, 8008 Burgas, Bulgaria.
E-mail: dinevds@gmail.com

Having in mind the assortment and the age structure, the tree composition and other specific peculiarities of the Bulgarian forests, as well as the timber market in national scale, about 70 % of the harvested timber is used for technological and energy purposes, e.g. for production of particle boards, cellulose and firewoods. In the last years the share of the categories "woods" and "brushwood" is about 50 % of the total timber harvested volume in Bulgaria. Practically, in our country the wood wastes from felling together with the brushwood are about 1.4 Mio solid m^3/yearly. They present significant energy potential but the degree of their quantitative concentration is low and often this resource is at big distances from the settlements. The most important advantages and benefits of the utilization of solid wood biofuels in the form of pellets, briquettes, charcoal and chips for energy purposes are: ecological – decrease of the carbon emissions and air pollution and economic (social in this account) – decrease of the costs of and for the energy, which guarantees economic and social effect for those using tree bio-fuels. In our country the volume of these wood energy products in 2014 is respectively: 53700 t pellets, 8700 t briquettes, 10610 t charcoal and 9400 t wood chips. About 60 % of the companies producing pellets (15–20 % of the total production) use small pressing machines. The general analysis of the wood pellet and briquette sales show that about 2/3 are realized for export based on preliminary signed contracts, explicitly after the

introduction of quality requirements. Most often the export is for Greece, Turkey and Italy. According to our assessments, the best conditions for development exist for the production of briquettes and wood chips for the internal market, of pellets for the external market and of charcoal for the both markets.

Key words: biofuels, briquettes, charcoal, chips, wood biomass, wood pellets.

TESTING AND IMPLEMENTATION OF TECHNOLOGIES INTO LOGGING DURING A JOINT USE OF SKIDDER, HARVESTER AND FORWARDER IN BULGARIA

Dinko Dinev[1*] and Jelio Vardunski[2]

[1]Oak Forest Experimental Station, Izgrev Complex, 8008 Burgas, Bulgaria.
[*]E-mail: dinevds@gmail.com
[2]Lestrans LTD, 22a M. Tolbuhin Str., 8120 Kameno, Bulgaria. E-mail: gamitreid@abv.bg

In the Eastern Stara planina, during a 3 year period with some intermittences due to repair works, the following technological schemes have been studied and implemented into the development: 1) felling of trees using a chain saw, haulage of whole trees by a skidder, felling, delimbing, bucking, cut-to-length (CTL) of full trees by a harvester and assortments transportation by a forwarder; 2) felling and a primary processing of trees by chain saws, haulage of assortments by a skidder and transportation by a forwarder and 3) felling and a primary processing of trees by a harvester and forwarder of assortments. The application of the respective technological scheme depends on the available forest-exploitation conditions. The following machines have been used for the purpose: TK 40 Bolgar and Universal-651 skidders, John Deere 1270 harvester and John Deere 1110 forwarder. The latter ones: John Deere 1270 and John Deere 1110 have been bought second hand (as used machines). The studies have been conducted in black pine cultures (*Pinus nigra* Arn.) and white pine ones (*Pinus silvestris* L.), growing on terrains of a hilly and up to a mountain character. The plantations state is as it can be expected in calamity forest stands (fires, windfalls, snowbreaks, calamities), but, regardless of that, though, usable for works which are to be performed by the studied machines. The forest-exploitation targets include a clearance of the above mentioned areas, i.e. the clear cuttings. Productivities from 26 up to 68 m^3/day have been achieved being its lower limit related to a technology where a chain saw is used while the upper one related to a completely machinized technology. As for the harvester and the forwarder, their productivities differ one from the other, taking into consideration that the size of the trees exerts a greater influence on the work performed by the harvester. Multi-operational machines operators` professionalism and experience are significantly

important for the implementation of the works and both professionalism and experience are gained by knowledge obtained in the course of a specialized training.

Key words: cutting area, time study, wood harvesting.

NATURAL AND ARTIFICIAL REGENERATION OF SUBALPINE *PICEA ABIES* (L.) KARST. FORESTS AFTER LARGE-SCALE WIND-DISTURBANCES IN VITOSHA NATURE PARK

Alexander Dountchev* **and Petar Zhelev**

Department of Dendrology, University of Forestry, 10 St. Kliment Ohridski blvd., Sofia 1797, Bulgaria. *E-mail: alexdountchev@hotmail.com

The regeneration of subalpine Norway spruce (*Picea abies* (L.) Karst.) forests is among the most challenging silvicultural issues, particularly after large-scale natural disturbances. The aim of the study was to compare the development of the natural and artificial regeneration in the period 2006–2014 in a cleared windthrow area of 14 ha, which resulted from a wind-disturbance in 2001 in Ofeliite site, Vitosha Nature Park. We found that the natural regeneration was most intensive during the first years after the wind-disturbance. Dominant species was *Picea abies*, which regenerated most often on decaying deadwood. The artificial regeneration was 5 times lower than the natural one what was explained by the low planting density and the higher mortality rate of planted spruce seedlings in comparison to the naturally established ones. In both cases the risk of mortality was highest among saplings lower than 0.5 m. The main reasons for the observed mortality were the withering and suppression by other species such as *Rubus ideaus* L. and *Calamagrostis arundinacea* (L.) Roth. Our results suggest that for the restoration of the wind-disturbed spruce forest in Ofeliite site natural regeneration is of higher importance than the artificial planting. In this respect, sustaining abundant seedling bank as well as sufficient quantities of decayed deadwood as regeneration substrate in the managed spruce forests can guarantee adequate natural regeneration after large-scale disturbances.

Key words: Norway spruce, mortality, planting, regeneration substrate, seedling bank.

CHANGES IN THE CONTENT OF CARBON AND NITROGEN IN THE SEEDLINGS OF EUROPEAN BEECH (*FAGUS SYLVATICA* L.) AND ENGLISH OAK (*QUERCUS ROBUR* L.) DURING THE GROWING SEASON IN 2014 IN THE CONTAINER NURSERY

Katarzyna Dudek[1*], Stanisław Małek[1], Józef Barszcz[1], Jacek Banach[2], Grzegorz Durło[3], Krystyna Jagiełło-Leńczuk[3], and Mariusz Kormnanek[4]

[1]Department of Forest Ecology and Reclamation, Institute of Forest Ecology and Silviculture, Faculty of Forestry, University of Agriculture in Kraków, Al. 29 Listopada 46, 31-425 Kraków, Poland. E-mails: k.dudek@ur.krakow.pl[*]; rlmalek@cyf-kr.edu.pl

[2]Department of Forest Tree Breeding, Faculty of Forestry, University of Agriculture in Kraków, Al. 29 Listopada 46, 31-425 Kraków, Poland. E-mail: rlbanach@cyf-kr.edu.pl

[3]Department of Forest Protection, Entomology and Forest Climatology, Institute of Forest Ecosystem Protection, Faculty of Forestry, University of Agriculture in Kraków, Al. 29 Listopada 46, 31-425 Kraków, Poland. E-mails: rldurlo@cyf-kr.edu.pl; j-krysia@wp.pl

[4]Department of Forest Work Mechanization, Institute of Forest Utilization and Forest Technology, Faculty of Forestry, University of Agriculture in Kraków, Al. 29 Listopada 46, 31-425 Kraków, Poland. E-mail: rlkorma@cyf-kr.edu.pl

Development of container nursery requires the optimization of the production including the adjustment of the fertilizer dose to the current seedlings supply for nutrients and climatic conditions in a particular country. In 2014, each two weeks the content of carbon and nitrogen in the roots, leaves, shoots of European beech and English oak and in a substratum was determined, in order to compare their contents with the optimal value for this species. Element content was determined using LECO CNS analyser. The highest concentration of nitrogen was found in leaves while at a similar level were in the roots and shoots. At the end of the test period in the case of beech and half of the period for the oak nitrogen content in shoots and roots was equal to the content in the substrate. The nitrogen content in the European beech leaves was above the optimum level at the beginning of the test period, then was within the optimal range and finally decreased below the optimum in the end of test period. Similar trend was observed in oak leaves too but exceeding the optimum value was in late July and early August. The carbon content was increasing throughout the period and had a balanced course for both analyzed species and the highest concentration of this element was found in leaves.

Key world: covered root system, fertilization, nutrients.

Financing: PGL LP BZ 761/KEkL/14-17(ER-2717/-4/14) Optimizing the production of seedlings with covered root system in the selected container nurseries.

SITE CONDITIONS FOR GROWING DOUGLAS-FIR IN CENTRAL EUROPE

Tamara Eckhart[1,2*], Marcela van Loo[1], and Hubert Hasenauer[1]

[1]Department of Forest and Soil Sciences, Institute of Silviculture, University of Natural Resources and Life Sciences, Peter Jordan Strasse 82, 1190 Vienna, Austria.
[*]E-mail: tamara.eckhart@boku.ac.at
[2]Centre for Climate Change Adaptation, alpS GmbH, Grabenweg 68, 6020 Innsbruck, Austria.

Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco), native to western Northern America, is the second most cultivated non-native conifer tree species in Europe. In the European forestry this conifer is seen as an alternative for several native tree species, exceeding them by wood quality, higher growth potential and growth stability even under dry conditions, which are predicted for the future climate. The large environmental heterogeneity within the broad native distribution range of this conifer is also reflected in different growth performances of Douglas-fir provenances. Consequently, the selection of suitable provenances and site conditions are of major importance to guarantee a successful cultivation outside its natural distribution range. For the present study, we examined i) the relationship between the site index and three environmental factors (climate, topography and soil) described by 58 variables and ii) the growing potential of the Douglas-fir on calcareous soil types. To perform the former, eleven Douglas-fir stands situated in Austria and Germany originating from the Western Cascades in Washington and Oregon were analysed. The influence of soil, climate and topography on Douglas-fir site index was evaluated by a multiple regression analysis. For the latter, six Douglas-fir stands planted on limestone/loess were investigated to elucidate the growing potential on these particular soil types. First results of the correlational study reduced the large number of variables of the three environmental factors to only seven where two soil variables such as nitrate and manganese explained about 73 % of the site index variation.

Key words: calcareous soil types, climate change adaptation, Douglas-fir site index, environmental drivers.

PRINCIPLES FOR THE FORMATION OF SPACES ALONG WALKING TRAILS IN FOREST LANDSCAPES

Emil Galev* **and Diana Koprinska**

Faculty of Ecology and Landscape Architecture, Department of Landscape Architecture, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria.
E-mails: emil.galev@abv.bg*; d.koprinska@macro-design.com

The panoramic views and attractive landscape fragments and landscape paintings are often the main focus in the construction of trails for hiking, cycling, mountain biking and horse riding. Most of them use the existing pedestrian routes that do not always provide the tourist demand landscape attractiveness. It is a serious study and application of compositional principles for the formation of spaces along the tourist trails to increase the mental-emotional impact of forest landscapes on tourists. The article discusses the application of the principles of landscape architecture for environmental friendliness, logical paths, optimal visual quality and landscape impacts on the tourists. Particular attention was given to the role of eco-trails as a prerequisite for creating unique landscape attractions, enhance cognitive nature of outdoor recreation and suggesting respect for nature by tourists.

Key words: panoramic views, pedestrian routes, recreation, visual quality.

NATURAL REGENERATION IN FIRE-AFFECTED PURE STAND OF *PINUS NIGRA* ARN. IN THE AREA OF TREBINJE

Zoran Govedar[1], Srđan Keren[1*], and Drago Petković[2]

[1]Faculty of Forestry, University of Banja Luka, 75 Stepa Stepanovic blvd., 78000 Banja Luka, Republic of Srpska/Bosnia and Herzegovina. E-mails: zoran.govedar@sfbl.org; srdjan.keren@sfbl.org*
[2]Public Forestry Enterprise „The Forests of the Republic of Srpska“, Romanijska 1/3, Sokolac, Republic of Srpska/Bosnia and Herzegovina. E-mail: drago_petkovic@yahoo.com

Natural regeneration of forests in fire-affected stands is characterized by different specifics compared to the regeneration of non-fire-affected areas. This paper deals with the problems of natural regeneration in natural pure stand of Black pine (*Pinus nigra* Arn.) in areas which were affected by low and high fire in 2003. Study site was located in the area of Trebinje (Republic of Srpska, Bosnia and Herzegovina). The age of most mature trees in the stand varied between 75 and 85 years. During 2014 we determined the number of seedlings, their quality and ground flora species diversity on the six plots

with a size 30 × 30 m each, of which three were placed within the stand part affected by low fire (SP1), and three plots in the stand part suffered from high fire (SP2). Except for wildfire influence, conditions such as inclination, exposure, altitude, soil type, etc., were virtually the same on both studied parts. Number of black pine seedlings on SP1 was greater (99 in total), while on SP2 it was 60. On the other hand, the average height of pine seedlings was greater on SP2 (1.18 m) compared to SP1 (0.42 m). In addition, basic stand structural elements were determined on SP1. Number of trees per hectare amounted to 311, basal area was 26.1 m^2/ha and growing stock 207.2 m^3/ha. Finally, ground vegetation diversity was analyzed on both stand parts, and thereby we placed special emphasis on those species which were assessed to be potential competitors to occurrence and development of black pine seedlings.

Key words: black pine, seedlings characteristics, wildfire.

NONINDUSTRIAL PRIVATE FOREST (NIPF) LANDOWNERS ATTITUDES TOWARD CLIMATE CHANGE AND FOREST CARBON SEQUESTRATION IN THE SOUTHERN UNITED STATES

Puskar Khanal and Donald L. Grebner*

Department of Forestry, Mississippi State University, Box 9681, Mississippi State, MS, USA.
*E-mail: don.grebner@msstate.edu

Over long time periods, sequestering forest carbon provides a high volume and low cost management opportunity. It is an efficient and effective approach for mitigating climate change. Few studies have evaluated nonindustrial private forest landowner (NIPF) attitudes towards climate change and carbon sequestration in the southern United States. This study segments NIPF landowners based on of their attitudes toward climate change and carbon sequestration. Project goals were to segment landowners into homogeneous attitude clusters and identify their major information sources and preferred communication strategies for getting climate change information. Study data was obtained from a mail survey which was implemented during the fall of 2013. A K-means cluster analysis was used for 11 carbon sequestration and climate change attitude questions from the survey instrument. Observed groupings were used to evaluate difference among the landowners in terms of their attitudes towards climate change risk perception, forest resource ownership, socio-economic characteristics, and communication strategies.

Key words: cluster analysis, mitigation strategies, regional survey.

SPECIFIC CHARACTERISTICS AND SOME ISSUES OF PROTECTION OF IMMOVABLE CULTURAL HERITAGE OBJECTS IN FOREST AREAS OF BULGARIA

Maria Gurkova

Department of Park and Landscape Design, Faculty of Ecology and Landscape Architecture, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria.
E-mail: maria_gurkova@abv.bg

This paper describes the diversity of immovable cultural heritage in forest areas of the country and attempts to identify the specific features of cultural values in a mountain area. Existing Cultural Heritage Act and its regulations acts represent fundamental criteria, indicators and guidelines for the evaluation of all heritage sites. Experience shows that real cultural values in a mountain environment, because of their specific need some further clarification of these indicators and evaluation guidelines. This is in direct relation to determining the extent of future intervention in the environment of which depends their adequate representation to the public.

Keywords: criteria, cultural values, forest environment, regulations.

PRINCIPLES OF LANDSCAPE ARCHITECTS IN REPORTING IMMOVABLE CULTURAL HERITAGE IN FOREST AREAS

Maria Gurkova and Emil Galev*

Department of Landscape Architecture, Faculty of Ecology and Landscape Architecture, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria.
E-mails: maria_gurkova@abv.bg; emil.galev@abv.bg*

Presentation of cultural heritage is carried out through exposure, marking access and promotion. In essence this is the activity for revealing the cultural and scientific value to society and is a key priority for the development of sustainable tourism. This activity ensures heritage socialization and integration into the environment and the needs of society in accordance with the principles of conservation. When the objects of heritage are in forest areas they have specific shape that is created not only by the vision of a particular object or complex, but also the environment in which it is established and where it exists. The article discusses the application of the principles of landscape architecture for complete expression of immovable cultural heritage situated in a forest environment under conditions and in a manner which does not jeopardize their physical integrity, condition and authenticity, protect them from any harm or adverse effects.

Keywords: cultural values, environment, exposure, sustainable tourism.

ASSESSING LIFE CYCLE COSTS FROM WOOD ENERGY FOR THE EU

Janez Krč[1*], Adriana Maria Nolasco[2], Adam Taylor[3], and Donald G. Hodges[4]

[1]Department of Forestry and Renewable Forest Products, University of Ljubljana, Večna pot 83, 1000 Ljubljana, Slovenia. [*]E-mail: Janez.Krc@bf.uni-lj.si
[2]Department of Forest Sciences, University of São Paulo – ESALQ, Piracicaba-SP, 13418-900, Brazil. E-mail: amnolasc@usp.br
[3]Department of Forestry Wildlife and Fisheries, University of Tennessee, 274 Ellington Plant Sciences Bldg., Knoxville, Tennessee 37996-4563, USA. E-mail: mtaylo29@utk.edu
[4]Natural Resources Policy Center, University of Tennessee, 274 Ellington Plant Sciences Bldg., Knoxville, Tennessee 37996-4563, USA. E-mail: dhodges2@utk.edu

A shift to renewable energy, including wood energy, will be crucial to reducing carbon emissions and ensuring the sustainability of human civilization and is a goal requiring strategic, tactical, and operational planning on multiple levels. With this growing use of wood energy, there is increased scrutiny of the associated environmental impacts and concern over possible unintended consequences (e.g. non-renewable energy inputs) that may detract from the carbon savings provided by such renewable energy sources. We propose a simple accounting system for the embodied fossil fuels in wood energy systems. This system is based on life cycle assessment (LCA) methodology and could accommodate fairly the variability in fossil fuel inputs for various bioenergy systems. Such a system could be incorporated into biofuel incentives or carbon taxation policies. We use three scenarios to illustrate that: 1) wood-to-energy systems entail the use of fossil fuels and that the amount of this "embodied fossil carbon" varies with the processing inputs and transportation required, and 2) carbon tax/biofuel subsidies can be adjusted to accommodate variations in embodied fossil carbon. We assess and discuss four alternative procurement paths for green energy generation. The first two scenarios evaluate long distance transport of biomass energy (pellets) from the southeastern US and from Brazil to Italy. The third scenario evaluates biomass (pellets), but with a relatively short transportation alternative of intra-EU energy provision from Slovenia to Italy. The final scenario assesses the impacts of wood chips produced in Slovenia and used for energy in Italy as a minimally processed and relatively local bioenergy alternative. The growth in life-cycle databases and the advent of environmental product declarations, makes embodied fossil fuel calculations such as those presented here an increasingly practical component of biofuels policy development.

Key words: bioenergy, carbon, international trade, life cycle assessment.

EFFECT OF CARBON ON OPTIMAL HARDWOOD MANAGEMENT REGIMES: AN ECONOMIC ANALYSIS

Donald G. Hodges

Natural Resources Policy Center, University of Tennessee, 274 Ellington Plant Sciences Bldg., Knoxville, Tennessee 37996-4563, USA. E-mail: dhodges2@utk.edu

Hardwood forests offer a wide array of benefits to society worldwide. Determining optimal management regimes, therefore, often requires considering multiple objectives, management tools, and values. Recently, managers and analysts have begun including carbon sequestration scenarios in their management planning as markets develop. While much of the initial work has been focused on even-aged management regimes, uneven-aged management scenarios are needed to fully explore the effects of these new markets on forest management decisions. This paper identifies carbon sequestration opportunities for a series of hardwood forest types and assesses how various carbon values could affect management returns for even-aged and uneven-aged stands. This was accomplished by first estimating future timber volume and carbon yields with initial stand values. These values were used to calculate economic returns to three distinct objectives timber production only, carbon only, and carbon and timber. Sensitivity analysis was conducted based on a range on product prices (timber and carbon), discount rates, and product mixes.

Key words: carbon sequestration, ecosystem services, optimal economic rotation.

COMPARATIVE STUDIES IN COMMON BEECH PROVENANCES TESTS IN BAVARIA AND BULGARIA

Gerhard Huber[1*], Krasimira Petkova[2], and Monika Konnert[1]

[1]Bayerisches Amt für forstliche Saat- und Pflanzenzucht, Forstamtsplatz 1, 83317 Teisendorf, Germany. E-mails: gerhard.huber@asp.bayern.de*; monika.konnert@asp.bayern.de.
[2]Department of Silviculture, Faculty of Forestry, University of Forestry, 10 Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mail: kpet@abv.bg

This study presents the results of a project, aimed to examine if Common beech provenances from Bavaria (South Germany) are able to adapt to different climate conditions in Bulgaria without any significant loss of vitality and productivity. For this purpose a transfer experiment with beech provenances from Bulgaria and Bavaria was established in both countries. Five trial-sites were installed with 2-year-old beech seedlings of 4 Bavarian and 3 Bulgarian beech provenances in autumn 2009 and spring

2010. During four years survival rate and height of beech plants of each provenance and replication were measured. At the end of the four-year study period we found highest average survival rate and best height growth on the trial-site Varbitsa (BG), the lowest in Vidin (BG). Generally, Bavarian provenances showed (till now) a satisfactory performance on Bulgarian trials sites, which confirm their plasticity and their suitability for cultivation under future climate conditions in South Germany.

Key words: climate change, *Fagus sylvatica* L., growth, plasticity, suitability for cultivation, survival rate.

EVALUATING OF THE NEW METHOD OF REFORESTATION OPERATIONS IN SEMIARID CONDITIONS

Seyed Mohammad Hosseini[1*], Alois Skoupy[1], and Achim Dohrenbusch[2]

[1]Department of Forest Harvesting, Czech University of Life Sciences, Kamýcká 1176, Prague, CZ – 165 21, Czech Republic. E-mails: s_hosseini99@yahoo.com[*]; skoupy@fld.czu.cz
[3]George-August University of Gottingen, Germany, E-mail: adohren@gwdg.de

Afforestation development in semiarid areas is not easy, because of the lack of water and the costs of irrigation. The objective of this research was to find a practical way for afforestation development and optimal and viable solution for creation and irrigation of planting in semiarid zones of Iran in collaboration with 3 domestic and 2 foreign universities from Germany and Czech Republic and Departments of forest and environment of Iran. This research was carried out at 50 kilometers to the south of Tehran known as Jajrood. This aim was arrived at by the use of a super absorbent material, bearing the trademark Hydrogel Super absorbent Stockosorb 300. In this study, 4 conifers species (*Pinus eldarica*, *Thuja orientalis*, *Cupressus arizonica* and *Cupressus sempervirens*) and 4 broadleaf species (*Robinia pseudoacaccia, Ailanthus altissima, Acer negundo* and O*lea eurpea*) were administered with 5 treatments. The results of the research proved that the type of treatment which had been employed had a positive effect on the aliveness of the saplings. From amongst the 8 species studied, *Robinia pseudoacaccia* proved to be the best species and *Cupressus sempervirens* the worst. In this paper, mortality of saplings and water irrigation for all conifers and broadleaves tree species in the semiarid regions will be discussed.

Key words: afforestation, aliveness, hydrogel, semi-arid, super absorbent.

LONGTERM DEVELOPMENT OF THROUGHFALL DEPOSITION IN A SENSITIVE FRESHWATER FORESTED CATCHMENT

Nadka Ignatova*, Maria Mladenova, and Sonya Damyanova

Department of Plant Pathology and Chemistry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mails: nadia_ignatova@abv.bg*, sonya_damyanova@abv.bg

Longterm ecosystem research in forested catchment in Petrohan area, used for drinking water supply, has been carried out in order to assess the risk of acidification. The time series are 25 years long. Deposition shows declining sulfate and nitrogen. The concentration of base cations has been decreased in both bulk precipitation and surface water showing the decrease of the neutralizing capacity of stream water. The mean value of pH for source water have been averaged as 5.99 pH units and for stream water at the same catchment area 6,68 pH units respectively. It has been found that the ratio between the sum of base cations (K^+, Na^+, Ca^{2+} and Mg^{2+}) and the sum of acidifying pollutants, like nitrogen sulfate and chloride, has been decreased for the period 1986–2014. Critical loads of acidity, sulfur and nitrogen have been calculated in order to determine the sensitivity of water bodies to the acidifying pollutants and the results obtained showed different sensitivity. A regional trend analysis for the sensitive surface water show increases in pH for the last 10 years, mixed trends for sulfates and dominating downward trends for nitrate. The time series analyzing has been shown that all critical loads of acidity, sulfur and nitrogen have been decreased showing the decreasing of the tolerance of the water ecosystems to the acidifying pollutants. The exceedances of critical loads were used to evaluate the risk of acidification. Although the high values of critical loads of acidity (more than 2000 $eq.ha^{-1}.yr^{-1}$) both critical loads of sulfur and nitrogen have been exceeded in 50 % of the territorial unites of the catchment area in concern because of high deposition of acidifying pollutants in both open field and throughfall of beech and spruce forests. The results obtained can be used by decision makers to reduce the atmospheric pollution.

Key words: acidification, bulk precipitation, beech and spruce throughfall, critical loads, risk assessment, water chemistry.

STUDY OF MILLING TECHNOLOGY UNIT PERFORMANCE FOR SITE PREPARATION OF FOREST AREA FOR AFFORESTATION

Velika Jordanova* **and Konstantin Marinov**

Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mails: veli_jordanova@abv.bg*; kmarinov_ltu@abv.bg

Contemporary technologies for afforestation of forest areas, based on the use of specialized milling units for soil preparation, mulching, shredding of stumps and other typical forest operations, are characterized by relatively high environmental and quality indicators, lower cost of labor and a smaller number of used technical means. These advantages are due to the use of specialized milling machines, which can operate in wide range for the strength and the type of deformation and interaction of the cultivated object. To achieve good results low technology speeds, more energy and powerful tractors are needed. This article represents some basic performance of forest milling aggregate PT-400, consisting of multi-purpose forestry tiller FAE-300/S and crawler CAT C-13. The survey has been carried out on experimental poplar sites and slashes along the Danube river valley in the region of Northwest Forestry Enterprise Vratza, within the State Forest Service – Office Lom and Office Oryahovo. For the purpose of the study are established the following parameters: fuel consumption, operating speed and operational performance of the milling unit under certain conditions: 1/ crushing stumps with diameters up d_{av} = 65 cm and mulching amorphous bushes with height of 2.5–3.0 m; 2/ milling of the soil to a depth of 50 cm. The obtained results will be useful for better determination and establishment of technological capabilities and performance of the studied specialized milling unit.

Key words: fuel consumption, operating speed, poplar plantations, productivity.

NECESSITY, OPPORTUNITIES AND PRIORITIES FOR DEVELOPMENT OF AGROFORESTRY IN BULGARIA

Lyubcho Trichkov[1*] and Vania Kachova[2]

[1]Projects and International Activities Directorate, Executive Agency of Forestry – Bulgarian Ministry of Agriculture and Food, 55 Hristo Botev blvd., 1040 Sofia, Bulgaria.
[*]E-mail: lptrichkov@abv.bg
[2]Forest Genetics, Physiology and Plantations Department, Forest Research Institute – Bulgarian Academy of Sciences, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria.
E-mail: vania-kachova@abv.bg

By its nature agroforestry is a form of multifunctional, environmental friendly and sustainable land management and could provide good income, employment, economic and social stability in many less favored rural and mountainous areas in Bulgaria. Achievements, policies, legislation, financial instruments and prospects for the development of agroforestry in Bulgaria are reviewed. Priorities and opportunities, such as development of agroforestry in mountainous areas of the country; renovation and establishment of new forest protective belts and coastal buffer agroforestry systems; introducing of new agroforestry practices in production of fruit productive trees with high value timber, in the production of fast growing tree species for yielding of biomass and in the forest farms, are proposed. We are pointing out the need for a comprehensive strategy and policy in this field, for facilitate financial access, and for introducing of an assessment system for "good practices" and new agroforestry technologies. Implementation of agroforestry systems in the practice would have important economic, environmental and social impact on the development of local communities and the society as a whole.

Key words: agroforestry systems, financial instruments, legislations, perspectives, politics.

WOOD IDENTIFICATION OF FABACEAE GENERA AND SPECIES BASED ON MICROSTRUCTURE AND DART-TOFMS

Peter Kitin[1*], Edgard Espinoza[2], Hans Beeckman[3], and Pamela McClure[2]

[1]Department of Bacteriology, University of Wisconsin, 1550 Linden Dr. Madison, WI 53706. USA. [*]E-mail: kitin@wisc.edu
[2]U.S. Fish & Wildlife Service, National Forensics Laboratory, 1490 East Main Street, Ashland, OR 97520-1310 USA.
[3]Royal Museum for Central Africa, Tervuren 3080, Belgium.

Fabaceae is the third largest family of land plants consisting of more than 19,000 species worldwide. The family includes important tropical timber species, some of which are listed as endangered by the CITES regulations. Traditional wood identification is typically performed at the genus level while species identification is difficult or often impossible. However, wood identification of species is often required in trade of commercial timber as well as for implementation of conservation policies (CITES, the Lacey act) for protection of endangered species. Here we present a method of wood identification based on comparisons of reference images of wood structure with images of unknown wood. The digital images contain quantitative information useful for the separation of genera or species which can be revealed either by image analysis or visually by direct comparisons of microphotographs. A visual key for wood identification of 12 Fabaceae tropical genera was developed which speeded up the process of identification and also improved precision beyond the traditional wood anatomy. Furthermore, we used DART-TOFMS (Direct Analysis in Real Time, Time of Flight Mass Spectrometry) which successfully separated the species.

Key words: chemical fingerprinting, endangered species, tropical rainforest, visual key, xylem anatomy.

MASS DYING OF COLCHIS BOX IN FORESTS OF RUSSIAN CAUCASUS

Galina B. Kolganikhina

Moscow State Forest University, 1 1st Institutskaya str., 141005 Mytischy, Moscow region, Russia.
Institute of Forest Science RAS, 21 Sovetskaya str., 143030, vil. Uspenskoye, Odintsovo area, Moscow region, Russia. E-mail: kolganihina@rambler.ru

The Colchis box (*Buxus colchica* Pojark.) is a tertiary relict and an endemic of the Colchis-Lazistan flora. It grows on river canyons and stream gullies in mountain forests

of Caucasus, forming 2nd or 3rd layer of complex stands from deciduous tree species. The species is brought in the Red Data Book of the Russian Federation. Mass weakening and dying box trees are observed in territory of the Russian Caucasus since 2009. The same take place in Abkhazia and Georgia. Complex researches on this problem are carried out in territory of the Sochi national park since 2011. The establishment of the reason of pathological process is one of the most important problems. With that end in view detailed phytopathological observation of Colchis box stands in different parts of the national park have been carried out. Also mycological, molecular-phytopathological and anatomical histochemical analyses of the affected plant organ samples, dendrochronological analysis, studying of the box health status dynamics have been carried out. Weakening and dying box trees are observed in plantings with various ecological-silvicultural parametres. Trees of different age suffer. Identical character of plant weakening is everywhere recorded. The pathogenic fungous complex in leaves and shoots is revealed. For the first time the fungus *Cylindrocladium buxicola* Henricot is revealed in the national park territory. Some scientists consider the harmful disease caused by *C. buxicola* as the cause of mass box dying in the Caucasian region. The observations in native ecosystems of the Sochi national park testify to more complex etiology of pathological process. In 2014 year Colchis box plantations in Sochi national park have been undergone new threat by reason of fast distribution invasive species of pest (*Cydalima perspectalis* Walker). Now the Colchis box is in serious danger.

Key words: *Buxus colchica*, *Cydalima perspectalis*, *Cylindrocladium buxicola*, health status, pathogenic fungi, Sochi National Park.

GENETIC MONITORING IN FORESTS – EFFORTS FOR A EUROPEAN IMPLEMENTATION

Monika Konnert[1*], Barbara Fussi[1], Hojka Kraigher[2], and Filipos Aravanopoulos[3]

[1]Bayerisches Amt für forstliche Saat- und Pflanzenzucht, Forstamtsplatz 1, 83317 Teisendorf, Germany. E-mails: monika.konnert@asp.bayern.de[*]; barbara.fussi@asp.bayern.de
[2]Slovenian Forestry Institute, Vecna pot 2, 1000 Ljubljana, Slovenia.
E-mail: Hojka.Kraigher@gozdis.si
[3]Aristotle University of Thessaloniki, University Campus, GR54124 Greece.
E-mail: aravanop@for.auth.gr

Sustainable forest management is based on a long-term adaptability of forest ecosystems and starts at the lowest, the gene level. Forest genetic monitoring (FGM) implies the long-term observation of the status and the temporal developments (changes) in the genetic system of forest tree populations on the basis of criteria, indicators and verifiers. As genetic variation is the basis of adaptability, forest genetic monitoring is a crucial

component of any sustainable forest management because it detects changes of forest adaptability before they are seen on higher levels. At the same time genetic monitoring is assumed to contribute essentially to the estimation and evaluation of the effect of influences on the genetic system in forests, thus making it an early warning and controlling system for ecosystematic changes. In the present contribution suitable criteria, indicators and verifiers for a FGM system are presented and the objectives of genetic monitoring are described. The recently started European LIFE project (LIFEGENMON) aims to define optimal indicators and verifiers for monitoring of genetic diversity changes in time across a transect from Bavaria to Greece for two target species, *Abies alba* and *Fagus sylvatica*. In the same time it intends to prepare guidelines for forest genetic monitoring for these two and additional five forest tree species at a national, regional and European scale, to elaborate a manual for implementation of FGM and to disseminate knowledge on the necessity for conservation of forest genetic resources in general and observation of changes through genetic monitoring in detail. The project objectives and the expected results will be presented.

Key words: *Abies alba,* criteria, *Fagus sylvatica,* Genetic monitoring, indicators, LIFEGENMON, verifiers.

ACTIVITIES OF SOIL MICROBE COMMUNITIES AT SPRUCE FORESTS CLEAR-CUTS OF THE EUROPEAN NORTH-EAST

Elena M. Lapteva*, Yulia A. Vinogradova, and Yury V. Kholopov

Soil Science Department, Institute of Biology Komi SC UrD RAS; 28 Kommunisticheskaya str., 167982 Syktyvkar, Russia. *E-mail: lapteva@ib.komisc.ru

This work aims at surveying the functional status of soil microbe communities (SMCs) from podzolic soils at chronosequent clear-cuts by the method of multi-substrate testing (MST). The study material was podzolic loamy soils under native bilberry green-moss spruce forest (plot SP1) and secondary different-aged deciduous-coniferous forests (SP2 – clear-cut 2001/2002, SP3 – clear-cut 1969/1970). SMCs were analyzed using soil samples from upper horizons (forest litter subhorizons O1, O2, O3; mineral horizons EL(hg) и ELBF). A general feature among them is decreasing assimilation of organic substrata going from organic to mineral soil horizons. SMCs of plot SP3 demonstrated the highest functional activity. There, microbiota consumed 37–44 of 47 organic carbon sources in forest litters and 8–37 in mineral horizons. The lowest consumption of substrata was shown by SMCs at plot SP2 (27–32 substrata). SMCs of native spruce forest took an intermediate position by its functional activity (33–38 in forest litters and 17–23 in mineral horizons). The highest metabolic activity *W* value (2042±122)

belonged to soil organic horizons of plot SP3. In native forest soil (SP1), it is 1.2 and in plot SP2 1.5 time as less compared to plot SP3. In mineral horizons of soil, the *W* values are 4–5 times as less than those in forest litters. The reverse dependence was found for mineral soil horizons, the highest metabolic activity belonged to native forest soil (1367±1021) and the lowest – to soil of plot SP3 (424±53). At plot SP1, SMCs of organic and mineral horizons had close total consumption values. Mineral horizons differed from forest litters only by a less active assimilation by microorganisms of pentoses and oligosaccharides and a better assimilation of aminoacids, polymeric (starch, dextrane, tween-80) and nitrogen-containing compounds. At plot SP2, the intensity of substrata assimilation decreased in all horizons. At plot SP3, it was characterized by an increased assimilation by microorganisms of oligosaccharides, aminoacids, polymers and nitrogen-containing organic compounds. SMCs at plot SP3 had higher values of Shennon index (5.1–5.4) and *d* (0.05–0.2) indices responsible for a stable status of soil microbe system. Unfavorable ecological conditions in podzolic soils at early after cutting succession stages due to temporal over-moisture, development of gleyzation processes, and high acidity of upper soil horizons hampered development of soil microbe complexes at early succession stages (newly-cut areas) that gradually re-covered at later stages (‘old’ secondary forests).

Key words: cuttings, functional diversity, microbiota, multi-substrate testing, podzolic soils, taiga forests.

IMPORTANCE OF REMOTE SENSING IMAGE ANALYSIS FOR MAPPING FOREST LAND COVER IN ŠUMAVA NATIONAL PARK

Polina Lemenkova

Faculty of Science, Institute for Environmental Studies, Charles University in Prague, 2 Benatska str., 12843 Praha 2, Czech Republic. E-mail: pauline.lemenkova@gmail.com

The study area is Šumava National Park (ŠNP), the largest of the four national parks located in the south-west of the Czech Republic, established as a special regime of environmental protection. A unique mosaic of forest habitats of exceptional natural value of European-wide significance, the ŠNP represents the largest terrestrial significant part of the Natura 2000 network in Czech Republic and Germany with unique mosaic of forest biotopes, rare, endemic and endangered species. It forms one of the largest forested areas between the Atlantic Ocean and the Ural. Recently, the ŠNP experienced changes in the landscapes and ecological community dynamics due to both natural climate changes and human impacts. Some parts of ŠNP are deforested and used for agriculture in the last decades. Most of the fields and meadow areas have been abandoned. Many species are threatened by the land-use changes. During the last decades some ecosystems` components are being gradually changed, degrading, some

endangered, rare, unique and important species are under extinction. As a result, the vegetation in the forest ecosystems is gradually changing and degrading. Human effects include fragmentation, and deforestation of original floodplain forests. Therefore, the questions of environmentally sustainable management is highly important and the future of nature conservation of ŠNP caused discussions and worries. Current paper contributes to the environmental mapping of this precious forest area. The research aim was to analyse how the forest landscapes has changed from 1991 up to 2009 (18-years) using remote sensing data and GIS. The data include GIS layers: raster Landsat TM images and vector thematic layers in ArcGIS format. Technically, the GIS project was made in Quantum GIS environment. Methodologically, spatial analysis was used to test the importance of the land cover changes in forest areas. The results include two maps showing the geographic distribution of land cover types within the 18-year period. The results visualized forest landscape dynamics in 1991 and 2009. They demonstrated effective application of QGIS software with multi-source geospatial data for environmental mapping of precious forest areas. The combination of remote sensing data and GIS tools for pattern recognition proved to be effective for geo-botanical forest research.

Key words: biogeographic mapping, forest conservation, landscape monitoring, spatial analysis.

DEVELOPMENT OF A HYBRID FOREST MAP USING UKRAINE AS A CASE STUDY

Myroslava Lesiv[1,3*], Anatoly Shvidenko[1], Dmitry Schepaschenko[1,2], Linda See[1], and Steffen Fritz[1]

[1]International Institute for Applied Systems Analysis, Laxenburg, A-2361, Austria.
E-mails: lesiv@iiasa.ac.at[*]; shvidenk@iiasa.ac.at; schepd@iiasa.ac.at; see@iiasa.ac.at; fritz@iiasa.ac.at
[2]Moscow State Forest University, Mytischi, 141005 Moscow, Russia.
[3]Lviv Polytechnic National University, 79013 Lviv, Ukraine.

The development of a high resolution forest cover map is a relevant task for countries that have not produced their own regional products (e.g. Eastern European countries such as Ukraine and Russia). During the last two decades, a number of global land cover products as well as global forest maps have emerged. However, the accuracy of these maps can vary considerably over space. Data fusion methods allow geographical information from available forest maps and ground-based data to be combined in order to produce a hybrid product of higher accuracy than any of the individual input maps. Here we have applied the method of geographically weighted regression (GWR) to generate a

hybrid forest (raster) map for Ukraine. This method predicts land cover types based on (1) crowdsourced data obtained from the Geo-Wiki project (http://geo-wiki.org/), which are assumed to be ground truth data, and (2) land cover/forest products derived from remote sensing (e.g. MODIS, GLOBCOVER, ESA/CCI, GLC-SHARE, MODIS VCF, LANDSAT-based Hansen's forest change). The hybrid forest map was developed in the R environment, which is a free statistical software with various geographical libraries. For validation of the hybrid forest map, we used independent crowdsourced data (also obtained through the Geo-Wiki project) indicating the presence or absence of forest. The hybrid forest cover for Ukraine was found to be more accurate than the individual forest maps extracted from global remote sensing land cover products. Moreover, the accuracy is much higher for the regions with a higher percentage of forest cover (i.e. in the northern part of Ukraine, in the Carpathian and the Crimean Mountains). However, the methodology presented here is highly dependent on the use of randomly generated points that are validated by volunteers through Geo-Wiki. The methodology can be used to create maps of other types of land cover (beyond only forest). For countries that do not currently have accurate enough land cover data, this approach provides an opportunity to develop national land cover maps that can be further used in different national, regional and global applications. Acknowledgement: The work was supported by Marie Curie grant FP7-MC-IIF: SIFCAS Project no. 627481.

Key words: forest cover, geographically weighted regression, remote sensing.

LANDSCAPE CHANGE TRAJECTORIES OF FORESTED WATERSHED UNDER TYPHOON DISTURBANCES IN TAIWAN

Chun-Kuo Yeh and Shyue-Cherng Liaw*

Department of Geography, National Taiwan Normal University, 10610 Taipei, Taiwan.
*E-mail: liaw@ntnu.edu.tw

This paper aims to study the landscape change trajectories of forested watershed in eastern Taiwan under the influences of frequent typhoons during 2005–2011. To demonstrate and grasp the dynamics of land cover change, this study applied the analysis of change trajectory and logistic regression. The results of change trajectory analysis indicated that three change trajectories, which covered 75.65 % of the total changed area, were considered the main change trends, including forest-landslide (from forest to landslide; FL), forest-channel (from forest to channel; FC), and vegetation recovery (from landslide to forest; VR). Based on the cause of land conversion, most land-cover transformation was found to result from natural change induced by natural disturbances. Therefore, natural force plays a pivotal role in the environmental change in the forested watershed.

The results of logistic regression analysis showed that lithology is the most important spatial determinant for the three change trajectories. As for the two variables, distance to faults and distance to rivers, negative logistic regression coefficients indicated that occurrence probability of the three change trajectories decreased with increasing distance to faults and rivers. Three maps of occurrence probability of the change trajectories were also produced by using regression coefficients. With the validation of the RCI index, the results revealed that the observed change trajectories considerably coincided with the zones that had higher probabilities of change and covered a small area. Thus, three spatial statistical models are helpful tools for predicting the occurrence probabilities of the change trajectories.

Key words: analysis of change trajectory, landslide, logistic regression, vegetation recovery.

RISK ANALYSIS OF POTENTIALLY INVASIVE PATHOGEN *PHYTOPHTHORA RAMORUM* FOR OAK FORESTS IN BULGARIA BASED ON CLIMATE DATA

Aneta Lyubenova[1*], Slavtcho Slavov[1], and Stefan Mirchev[2]

[1]AgroBioInstitute, 8 Dragan Tsankov blvd., 1164 Sofia, Bulgaria.
E-mails: anetta7@abv.bg[*]; sbslavov@abi.bg
[2]University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria.
E-mail: stemir_bg@yahoo.com

Bulgarian forests covers about 30 % of the country's area. 35 % of the deciduous woodlands are occupied by oak forests. The Oak decline phenomenon, which is causing much concern in Europe is now suggested to be induced by multiple stresses, including pathogens from genus *Phytophthora*. *Phytophthora ramorum* Werres, De Cock & Man in`t Veld, is an invasive oomycete pathogen, casual agent of the disease Sudden Oak Death (SOD). Since its emergence in 1993, the pathogen is spreading in many countries in Europe. Under climate change the negative role of pathogens like *P. ramorum* for oak forests is expected to increase. There are several computer based models available to project future distribution of forest pathogens using climate variables. Taking into account the ecology and epidemiology knowledge of *P. ramorum*, we present a risk analysis model of eventual *P. ramorum* establishment and spread in Bulgarian oak forests. Data from several meteorological stations, covering different forest vegetation zones in Bulgaria were used. The impact of the climate conditions on the pathogen and host development was defined, based on six level scale, calculated for the different biogeographical areas in Bulgaria. The presented risk analysis model is adapted to the

three forest vegetation zones on the territory of Bulgaria and the potential vulnerability of oak to SOD.

Key words: climate change, oak decline, monthly temperature and precipitation, Sudden Oak Death (SOD).

RAPIDEYE DATA FOR MAPPING AND MONITORING FOREST DISTURBANCE IN TANZANIA, AFRICA

Sizwe Mabaso[1], Peter Bunting[1], Andrew Hardy[1], Sandra Brown[1, 2], Richard Lucas[1, 3], Erik Naesset[4], Terje Gobakken[4], and Nuru Kaniki[5]

[1]Earth Observation and Ecosystem Dynamics Laboratory, Aberystwyth University, Wales, United Kingdom. E-mail: sdm5@aber.ac.uk
[2]Winrock International, Arlington, Virginia, United States of America.
[3]Centre for Ecosystem Science, University of New South Wales, Australia.
[4]Department of Ecology and Natural Resource Management, Norwegian University of Life Sciences, Norway.
[5]Miombo Woodland Research Centre, Tanzania Forestry Research Institute, Tabora, Tanzania.

High-resolution remote sensing data provide unprecedented opportunities for detecting and monitoring forest disturbance and losses. Disturbance and loss have been successfully mapped where the cleared land is of sufficient extent to provide discrimination within an image. However, methodologies for mapping and monitoring forest degradation are still lacking, primarily because these features are small in size. In Tanzania, the size and extent of degradation is therefore currently unknown, yet there has been an increase in shifting cultivation, infrastructural and settlements developments, logging and charcoal burning of indigenous trees. The study sought to first establish a forest/non-forest baseline and then develop a method for detecting forest disturbance, with a focus on degradation in Liwale, Tanzania, using RapidEye data. A baseline was derived using Land Cover Classification System (LCCS) approach from a 2012 RapidEye image, and validated using 2012 LiDAR data at pixel level and 30 m ($R^2 = 0.75$), 100 m ($R^2 = 0.81$) and 250 m ($R^2 = 0.82$) grids, a satisfactory result for the highly heterogenous woody savannas (miombo). The baseline was then used to perform a feature-based change detection analysis on a 2014 image. Resultant possible features of change were further quantified into either degradation, deforestation or seasonality. Major conclusions include that a baseline and change detection approach applicable to Tanzanian REDD+ initiative were produced. Major causes of disturbance were found to be shifting cultivation, fuelwood and timber harvesting, and wild fires. The results show that RapidEye has great potential for mapping and monitoring Tanzanian forests as a methodology for undertaking it was successfully developed. Moreover, it was concluded that the methodology is robust, and

thus can be scaled up to a broader national scale and similar environments within the Southern African Development Community. However, there is a very narrow window where features are separable in the heterogenous Tanzanian forests. Moreover, there is poor spatio-temporal RapidEye data over Tanzania, partly due to persistent cloud cover in the region throughout the year, but also due to high costs for acquisitions.

Key words: detection, degradation, forest/non-forest, LCCS, REDD+, savannas.

CONSEQUENCES OF *IPS TYPOGRAPHUS* ATTACK ON SPRUCE FORESTS IN EASTERN PART OF THE REPUBLIC OF SRPSKA, BOSNIA AND HERZEGOVINA

Zoran Stanivuković and Dane Marčeta*

Faculty of Forestry, University of Banja Luka, 75a Stepe Stepanovica blvd., 78000 Banja Luka, Republic of Srpska, Bosnia and Herzegovina. E-mails: zoranstanivukovic19@yahoo.com; danemarceta@sfbl.org*

An intensive dying of Norway spruce (*Picea abies* L.) forests in the Republic of Srpska was observed in the period 2011–2014. The fallen trees were evidenced as accidental revenue and should be removed from the forest within a sanitary felling. After felling and processing it was seen that technical quality of assortments from damaged trees was lower as compared to the trees harvested in a regular, healthy spruce stand. Aim of this research was to determine which factors caused intensive spruce dying in the eastern part of Republic of Srpska and to which extent technical quality of wood decreased. Investigation was done in the area of municipalities Sokolac, Han Pijesak and Foča in state forests, managed by Public forest company "Šume RS". In each area one stand with damaged trees was chosen and a total of 30 trees were felled and examined. Trees were processed and real and potential assortment structure was determined, considering all damages affecting technical quality of the stem. Bark pieces (10×10 cm) were removed at each 1 meter length of the stem for recording the pests (entomofauna). Other relevant data for investigated area were collected also, mostly concerning climate data (precipitation, temperature etc). Results showed presence of several pests and of them *Ips typographus* (L.) was recognized as the main factor causing spruce dying. Analysis of assortment structure of trees showed that for severely damaged trees – without bark and with dry needles (categories III and IV) wood quality rapidly decreased, but for the trees at the early stage of pests attack (categories I and II) technical quality of wood remained almost the same as that of healthy trees.

Key words: pests, quality, trees dying, wood.

ANALYSIS OF THE HUNTING GROUNDS OF VLAINSKO-MALESHEVSKA HUNTING MANAGEMENT AREA IN THE REPUBLIC OF MACEDONIA

Goce Nikolovski[1*], Vojo Gogovski[2], Dejan Mandžukovski[1], Vlatko Andonovski[3], Jane Acevski[3], and Nikolčo Velkovski[3]

[1]Public Enterprise "Makedonski Sumi", 128 Pero Nakov str., MK-1000 Skopje, Republic of Macedonia. [*]E-mail: gonik@yahoo.com

[2]Ministry of Agriculture, Forestry and Wather economy, 2 St. Amintha Treti str., MK-1000 Skopje, Republic of Macedonia.

[3]Faculty of Forestry, 16 Makedonska brigada br.1, Ss. Cyril and Methodius University in Skopje, MK-1000 Skopje, Republic of Macedonia.

Vlainsko-Maleshevska hunting management area is located in the eastern part of the Republic of Macedonia and covers a larger border area with neighboring Republic of Bulgaria. It coincides with the region and Malesh and Pijanec which includes municipalities or hunting areas of Delchevo with Makedonska Kamenica and Berovo with Pehchevo. This hunting management area includes a total of 13 hunting grounds, of which 7 are from hunting area Delchevo and 6 of the hunting area Berovo. They extend over an area of 138,730 ha of which 94 % is hunting area. Most of this area belongs to the hunting grounds of the hunting area Berovo with 77,800 ha or 56 % of the total area, while the hunting grounds of the hunting area Delchevo has 60,930 ha which is 44 % of the total area of all hunting grounds that belong to this hunting management area. In the hunting grounds of this area are present many kinds of wildlife (wild game), including those with special hunting-management significance: the European roe deer, Wild boar, European rabbit and Grey partridge. Other types of game because of their small representation are not of special hunting importance. Due to the border with neighboring Republic of Bulgaria, there are frequent migrations of the game from one country to another. As a result of these migrations in some hunting grounds of the border area has recorded the presence of the bear, which is not common in the hunting grounds of Vlainsko-Maleshevska hunting management area. In the hunting grounds along the border between Republic of Macedonia and Republic of Bulgaria is evident the increased presence of deer and Wild boar, in part because of the hunting grounds for small game hunting area in Delchevo they are treated the same as the main types of small game: European rabbit and Gray partridge. The paper includes several features of the hunting grounds of this hunting management area, such as: the total hunting area, hunting productive area (by total and by major hunting game species) hunting unproductive area, non-hunting area, the numbers of the main hunting game species, the population growth of the game, capacity of the hunting grounds, the year of the achievement of capacity of the hunting grounds, maximum number of game that can

be removed in the hunting grounds of this hunting management area according to the Special hunting management plans, and analysis of the number of main hunting game species between the last, and the new hunting period.

Key words: capacity, European rabbit, European roe deer, Grey partridge, Special hunting-management plans, Wild boar.

RESPROUTING ABILITY AND SPROUT GROWTH DYNAMICS IN TEMPERATE TREES AFTER HEAVY DISTURBANCES

Radim Matula* **and Martin Šrámek**

Department of Forest Botany, Dendrology and Geobiocoenology, Faculty of Forestry and Wood Technology, Mendel University in Brno, 3 Zemědělská str., 613 00 Brno, Czech Republic. *E-mail: radim.matula@mendelu.cz

Resprouting is a common mechanism of persistence of woody species in frequently disturbed ecosystems such as fire-prone shrublands, savannas and Mediterranean woodlands as well as in infrequently disturbed forests from the temperate zone to the tropics. After severe disturbances such as fires, windstorms and harvests, when all or most of the above-ground biomass is destroyed, woody species with the ability to resprout ('resprouters') quickly recover by producing new sprouts from dormant buds located in the remaining above- or below-ground organs. Because sprouts grow much faster than seedlings, resprouting trees often dominate forest regeneration and subsequent successional stages; thus, sprouting plays an important role in forest dynamics by affecting forest structure, composition and diversity. Although resprouting ability is common in many tree species, great deal of damaged trees always fail to resprout after a disturbance, but the main processes that drive resprouting success or failure and subsequent sprout growth are still little known. To address this gap, we have followed individual development of approximately 5000 spatially located trees one year before and six years after their harvest. This long-term study has been done in two experimental plots in the Czech Republic as well as in several countries of South-East Europe. For this purpose, we developed reliable method for measuring biomass in multi-sprout trees which was previously lacking. Our results showed that, apart from species identity, pre-harvest above-ground as well as below-ground competitions play the most important role in resprouting success of harvested trees, whereas pre-harvest tree size and sprout competition are the main drivers of sprout growth dynamics. Because resprouting ability is almost universally driven by the level of resource storage in individual plants, our results may be applied in a variety of terrestrial ecosystems with woody vegetation. Our findings suggest that especially competition has a variety of major effects on the

sprouting behaviour of temperate trees and that these previously unknown effects play important roles in the population dynamics of forest trees after heavy disturbances.

Key words: competition, resource storage, harvest, sprouting ability, tree mortality.

CREATING OF GEOPORTAL SERVER AS A PLATFORM FOR RESEARCH AND TRAINING AT THE UNIVERSITY OF FORESTRY

Radoslav Miltchev[1*] and Maria Asenova[2]

[1]Department of Computer Systems and Informatics, Faculty of Business Management, University of Forestry, 10 St. Kliment Ohridski blvd., Sofia 1797, Bulgaria.
[*]E-mail: rmiltchev@abv.bg
[2]Department of Forest Management, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., Sofia 1797, Bulgaria. E-mail: m_asenova@abv.bg

The University of Forestry is an educational and scientific institution, which has established itself over the years as an example of deployment and use of modern information and communication technologies to improve research and educational activities. Geographic information systems evolve dynamically in the last decade and enable storage, updating, analysis and visualization of spatial data. The recent trends of research in this area show that they are a powerful tool for managing forest areas and evaluate new aspects in the development of the environment, becoming a mandatory element in the conduct of any modern scientific research. The present paper aims to study the implementation of new information services available through specialized portals for educational purposes in the field of forestry, ecology, business management and etc. These services, collectively called geoportals are related to management and access to georeferenced information. They provide a wide range of options for accessing, editing, analysis and visualization of information in the form of specialized maps and attribute data and / or related various other information sources in the form of metadata. Geoportals or geo-libraries can become a reliable means to support research and education. This is accomplished by providing a single point of access to information assets cataloged, standards-based metadata accessible through widespread and free tools such as browsers and services for analysis, validation and collection of georeferenced information and metadata. Successful implementation of geoportals requires detailed investigation focused on intuitive organization and catalogization of spatial information and metadata, as well as research in the field of evaluation and structuring of the information available in terms of their future use by researchers, students and other users with an interest in the field. As the basis of the study are organized spatial data related to Forestry Experimental and Training Centers at the University of Forestry

and information from regional and national databases tailored to the learning process and the ongoing university research. The existing specialized data has been created as a result of the field and form the basis of multifunctional and forest management of the FETC which is very important to all aspects of the forest economics and sustainable management. As a result, by a geoportal will be created conditions for generalization and use of consumers data collected for over 60 years of data for training objects and experimental areas of the University.

Key words: GIS, metadata, spatial data.

STRUCTURE ANALYSIS OF A LOWLAND *QUERCUS PUBESCENS – QUERCUS FRAINETTO* FOREST IN NORTH-EASTERN GREECE

Elias Milios*, Kyriaki Kitikidou, Stelios Chatzakis, and Maria Batziou

Department of Forestry and Management of the Environment and Natural Resources, Democritus University of Thrace, Pandazidou 193, 68200 Orestiada, Greece.
E-mails: emilios@fmenr.duth.gr*; kkitikid@fmenr.duth.gr; stelarasdiom@yahoo.com; batzioumaria@gmail.com

The aim of this study was to analyze the diameter structure of a *Quercus pubescens – Quercus frainetto* remnant forest in North-eastern Greece. The main disturbances acting in the study area are illegal cuttings and grazing. Two site types are found in the studied forest as a result of different grazing pressure. In site type A, where the grazing pressure is not as intense as in site type B, there are *Quercus pubescens – Quercus frainetto* degraded stands. Site type B is covered by *Quercus pubescens* Willd. degraded stands. In each site type, a plot of 100 m x 100 m was established. Each plot was divided into four subplots of 50 m × 50 m (A, B, C and D subplots), where the breast height diameter of all the trees having a diameter of over 4 cm was measured. For all subplots and the A+B and A+B+C+D plots the Anderson-Darling statistic was used in order to examine in which typical distribution their diameter distribution is fitting better. This procedure took place for the investigation of diameter structure spatial heterogeneity. Both species present low basal area and do not exhibit large diameters. In site type A, the larger trees of *Quercus pubescens* appear in greater diameter classes compared to the largest trees of the species in site type B. In site type A, *Quercus pubescens* present higher basal area than *Quercus frainetto*. The main conclusion of this study is that there is a significant spatial heterogeneity in tree diameter structure of these stands. This heterogeneity is a combination of different shapes of diameter distributions, as well as of differences in basal area and number of trees in the different plots. The understanding

of the structure of these rare for Greece stands will contribute to the protection and sustainable management of them as well as of analogous ecosystems.

Key words: degraded forest, stand heterogeneity, remnant forest.

VARIATION OF THE ACID-BASE PROPERTIES OF FOREST SOIL AND LITTER UNDER DIFFERENT TREE SPECIES AFFECTED BY FOREST FIRES IN SOUTH-EASTERN BULGARIA

Ibrahim Molla* **and Emiliya Velizarova**

Department of Forest Ecology, Forest Research Institute – BAS, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria. E-mails: mollata@abv.bg*, velizars@abv.bg

Acid-base properties in cinnamonic forest soils (Chromic Luvisols) and forest litter under different fire-affected stands of tree species have been studied. The samples were taken immediately after fire, 1 month, 3 months and 1 year after fire from fire affected and from unaffected (control) areas. The depth at which soil sampling was performed was from 0 to 5 cm, from 5 to 20 cm and from 20 to 40 cm.The soil and litter acidity (pH) was measured potentiometrically in an aqueous extract.The most pronounced changes in pH values in comparison with the control variants was established in soil samples, taken from influenced by a surface fire broadleaf stand of *Quercus pubescens* Willd. The pH changes in the samples from the forest litter were more pronounced than the changes registered in the soil samples. A trend of a soil acidity increase was established till one year after fire influence for Austrian pine plantations and oak stands.

Key word: cinnamonic forest soil, soil acidity, *Pinus nigra* Arn., *Pinus sylvestris* L., *Quercus pubescens* Willd.

WOOD-DECAYING FUNGI AND THE CARBON CYCLE OF FOREST ECOSYSTEMS

Victor A. Mukhin* **and Daria K. Diyarova**

Ural Federal University named after the first President of Russia B.N. Yeltsin, 19 Mira str., 620002 Ekaterinburg, Russia. *E-mail: victor.mukhin@ipae.uran.ru

The carbon cycle in forest based on a combination of the two processes − 1) photosynthetic conversion by woody plants of CO_2 in organic form and 2) oxidative conversion of carbon of woody pool in CO_2. Annually in forest of Russia deposited 240–270 Mt of carbon and about the same amount (255 Mt) enters to chains of decomposition with woody debris from the decomposition of which is emitted 213 Mt C–CO_2. A major role

in the conversion of woody carbon to CO_2 plays wood-decaying basidiomycetes fungi, biosphere value which as the main decomposers of wood is clearly underestimated. The results of our studies supported by the RFBR (projects 12-04-00684, 15-04-06881) on the decomposition of woody debris by fungi allow us to make a number of conclusions. 1. CO_2 emissions from debris determined by CO_2-emission activity of fungi, which depends on hydrothermal conditions: direct linear relationship with the humidity and temperature in their range, typical for the boreal forest. It makes the fungal part of carbon cycle of the boreal forest extremely sensitive to climate change: CO_2 emissions will increase almost twofold with every temperature increase of 10 °C and a relative humidity of 10 %, until reaching a maximum at 30–35 °C and 55–70 % humidity. 2. Fungal destruction of debris is accompanied not only CO_2 emissions, but also methane, produced by or methanogenic archaea associated with fungi, or themselves fungi. This phenomenon requires further analysis to disclose the mechanism and factors of woody debris methane activity. 3. Wood-decaying fungi significantly alter the isotopic composition of carbon of debris, but they have not effect on the isotopic composition of nitrogen. The fractionation of isotopes of carbon and nitrogen by fungi leads to the significant environmental results. First – to accumulation of heavy carbon isotope in the soil and light in the atmosphere and second – to the close type of forest nitrogen cycle since a wood-decaying fungi act as geochemical traps and preventing its removal from the forest. All this shows the importance in the carbon and nitrogen cycle of forest ecosystems of wood-decaying fungi and the need to study them as biosphere-important organisms.

Key words: carbon dioxide, climate, emission, methane, nitrogen, woody debris.

INVESTIGATION OF THE DRY STRESS EFFECT ON THE WATER CONSUMPTION AND THE TREE GROWTH WITH THE USE OF LYSIMETER

Jürgen Müller

Thünen-Institute, Institute of Forest Ecosystems, Alfred-Möller Strasse 1, 16225 Eberswalde, Germany. E-mail: juergen.mueller@ti.bund.de

Broad areas of the northeast German lowlands are characterised by low precipitation, distinct periods of summer drought and sandy soils with low water retention capacity. In this region, forest hydrology research looks into the influence of differently structured forest on the landscape water balance.

The use of different types of lysimeters in this region has a tradition of more than 100 years. The Eberswalde lysimeters are excellently suitable for the complex investigations

because of her size (100 m² of surface and 5 m of depth). The investigations are completed by the use of especially developed weighable lysimeters and an open field laboratory. The main advantage of lysimeter techniques is the opportunity they offer to balance energy and nutrient flows at a high resolution under carefully differentiated conditions. Due to their innovative measurement techniques (weighing cells for determining moisture changes and seepage flows, soil moisture sensors and tensiometers for observing seepage water movement) lysimeters are an important instrument for the parameterisation of process models. Lysimeters are indispensable in investigations of water consumption of small forest trees of different origin in the face of increasingly limiting water resources arising from climate change.A main topic of the research is to investigate the water consumption and the growth of small trees at decreasing water resources. The ability of trees to adapt to climate change is still unexplained in the main. The investigation of their yield capacity under the conditions of drought and heat is a declared research objective. Main emphasis of the research consists in the investigation of cause and effect relationships under the conditions of different levels of drought on water consumption, radial growth and fine root dynamics of the trees. Young trees are more sensitive to dryness because their roots cannot reach the water content in deeper soil layers. The relationships between increasing soil water drying and evapotranspiration of young beeches and oaks are represented. The decrease of evapotranspiration is followed by the reduction of radial growth. The results are important to the sustainable forestry in "Future Forests".

Key words: climate change, radial growth, tree species, water shortage.

EFFECTS OF DIFFERENT SOWING TREATMENTS ON CAUCASIAN ALDER (*ALNUS SUBCORDATA* C.A.MEY.) SEEDLING GROWTH

Fatemeh Hassanpour[1], Farid Kazem Nezhad[2], Bahram Naseri[3*], Afsaneh Rezaei[1], Mehdi Kia Daliri[1], and Farshad Khodabakhsh Reshad[1]

[1]Afforestation, parks and reserves bureau, Forests, Rangelands and Watershed Organization, Chalus, 46619-53537, Iran. E-mails: fatemehhasanpur@gmail.com; rezaei.afsane@gmail.com; kia_daliri_mh@yahoo.com
[2]Islamic Azad University, Chalus branch, Chalus, 46615-397, Iran. E-mail: farid.avijdan52@gmail.com
[3]Department of Forestry, Faculty of Natural resources and marine science, Tarbiat Modares University, 76489-46417, Noor, Iran. [*]E-mail: bnasery@gmail.com

Present study implemented to determine optimum seed sowing density, depth and seed bed cover of Caucasian alder (*Alnus subcordata* C.A.Mey.) seedling growth. Seed sample was taken from Kelardasht nursery and was sown in a private nursery according

to complete randomized plot after determination of analytical traits. Treatments included seed sowing density (2, 3 and 4 g/m^2), depth (0.5, 1.0 and 1.5 cm) and seed bed cover (rice husk, tea cake and litter riddled). Seeds were sown in three replicates (1 m^2), totally 27 m^2. Seeds were sown at 1 cm both in bed cover and density experiments. A 3 g/m^2 were sown in both depth and bed cover treatments. Parameters included total number of seedlings, number of standard seedlings, collar diameter, seedling height and height/diameter. After seven months of growing period measurements showed the major significant differences ($P < 0.05$) in two measured indices. Mean total number of seedlings per 1 m^2 increased from 82 to 132 in accordance with increasing of sowing depth (0.5 to 1.5 cm). More regular trend observed in number of standard seedlings (42.71 and 89 seedlings/m^2). Increasing of seed density from 2 to 3 and 4 g/m^2 increased total number of seedlings (75.131 and 132 seedlings/m^2). But number of standard seedlings per 1 m^2 didn't increase consistent with seed consumption. Bed cover effects were the same on both total number of seedlings and number of standard seedlings. Results of rice husk and litter drilled were the same and had better effects than tea cake. Other indices (seedlings diameter, height and height/diameter) did not show sensible effects in different treatment types and levels. According to findings of this study, depth play an important role than density and bed cover for Caucasian alder seedling production that may relates to small seed size and light dependence of an important pioneer species from Hyrcanian forests. On the basis of results, sowing of 2 g of Caucasian Alder seeds at a depth of 0.5 cm, covered with rice husk or litter drilled can be recommended for producing the highest number of standard seedlings.

Key words: bed cover, density, depth, seedlings.

CARBON STOCKS IN COMPONENTS OF NATURAL EUROPEAN BEECH ECOSYSTEMS AFTER THINNING ACTIVITIES IN CENTRAL BALKAN

Lora Naydenova[1*], Angel Ferezliev[2], and Miglena Zhiyanski[1]

[1]Department of Forest Ecology, Forest Research Institute – BAS, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria. E-mails: l.naydenova@gmail.com[*]; zhiyanski@abv.bg
[2]Experimental Station on Coniferous Forests, Forest Research Institute – BAS, 44 Han Asparuh blvd. 4600 Velingrad, Bulgaria. E-mail: obig@abv.bg

Forest can contribute to the offsetting of greenhouse gasses emissions by sequestering carbon in biomass, deadwood and soil. Changes in forest soils are important to global C balance and the rate of change in soil C is also fundamental for and to local ecosystem functions. We studied the carbon stocks in the wood biomass, forest floor and soils in

two European Beech ecosystems – one control plot and one forest managed by thinning. Concerning the cumulated forest floor its quantity was 3 times higher in the control (18 t·ha^{-1}) compared to the managed one (4 t·ha^{-1}). The measured mean carbon content was higher in the upper 0–10 cm soil layer for the both plots – 6.25 ± 1.54 % C for the control and 6.83 ± 0.65 % C for the managed plot, and decreased toward deeper layer. We observed slight trend of increasing in C stock in the top 10 cm of soil in the managed plot, 10 years after thinning and supposed that better microclimatic conditions and faster processes of decomposition could be an explanation for this. Models were tested to describe the correlations between the biomass stock and other dendrometrical indicators – mean diameter, height and length of the tree crowns. We identified correlations between the volume of biomass stock, dendrometrical and biometrical indicators with the carbon stock.

Key words: accumulated carbon, dendrometrical indicators, forest management.

OPTIMIZATION OF FINANCIAL RESOURCES IN BULGARIAN FORESTRY AFTER THE REFORM IN 2011

Nikolay Neykov* **and Anna Dobritchova**

University of Forestry, 10 St. Kliment Ohridski blvd., Sofia 1797, Bulgaria.
E-mails: nkneykov@gmail.com*; ani_dobrichova@abv.bg

This paper presents the model which was developed during a research, conducted in the University of Forestry, Bulgaria. It is a mathematical model for optimal resource allocation through distribution of revenues and costs between different activities made by Forestry Enterprises. The main results are focused on one hand, on the optimal structure of cross financing between main profit centers, and on the other hand, on perspectives for economies in operational and strategic meaning. The optimization revealed that forestry needs greater diversity of business activities. It has to achieve five to ten percent yearly economies of costs. Cost effectiveness is the key factor for future development of Bulgarian forest sector. Activities like administration and management should be considerably re-examined and optimized.

Key words: allocation, efficiency, financial mechanisms, optimality.

SYNTAXONOMIC ANALYSIS OF FOREST VEGETATION IN CENTRAL BALKAN NATIONAL PARK

Ivailo Nikolov[1*] and Marius Dimitrov[2]

[1]Directorate Central Balkan National Park, 3 Bodra smyana str., 5300 Gabrovo, Bulgaria.
[*]E-mail: ivodimnik@abv.bg
[2]Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria.

National Parks are important part of the network of protected areas that preserve the biodiversity and the objects of non-living nature. Diversity of plant communities is a key element of the biodiversity. It is the function of specific abiotic, biotic and historic factors. Plant communities and their ecological characteristics are the basis for the identification and protection of the natural habitats. Object of this study are forest communities in National Park "Central Balkan". The park territory overlaps with the territory of the Special Protection Area (Natura 2000). It preserves more than 40,000 hectares of forests. A sufficiently complete classification scheme of the vegetation in the park, based on detailed floristic and ecological studies, has not been made until now. That is why this study aims to examine the syntaxonomic diversity of the forest vegetation in the National Park "Central Balkan". Braun-Blanquet approach has been used. 786 relevés had been set and analyzed and large GIS database had been created. Specialized software (JUICE, TWINSPAN, STATISTICA, etc.) has been used to accomplish the classification and ordination analysis. A detailed environmental characterization of the plant communities has been made. As a result of the syntaxonomic analysis were established phytocoenoses, divided in 4 classes (Querco-Fagetea, Quercetea pubescentis, Erico-Pinetea, Vaccinio-Piceetea), 4 orders и 10 alliances. 12 habitat types of Natura 2000 and 17 habitats of the Bulgarian Red Book were identified in the study area, based on the phytocenotic and environmental characteristics. The main conclusion is that the large area, the geographic location, the various environmental conditions and the great altitude range of the National Park "Central Balkan" determine the wide syntaxonomic diversity of forest vegetation and a variety of natural habitats. These results could be used as sound basis for making proper management decisions.

Key words: classification, diagnostic species, environmental variables, forest habitats, ordination, phytocenoses.

ON THE PHYSICAL NATURE OF THE ATMOSPHERIC GREENHOUSE EFFECT: A NEW PERSPECTIVE AND ITS IMPLICATIONS FOR UNDERSTANDING OF FUTURE CLIMATE CHANGE

Ned Nikolov* **and Karl Zeller**

N&T Services LLC, Fort Collins CO, USA. E-mails: ntconsulting@comcast.net*; kzeller@colostate.edu

The basic physics of the atmospheric Greenhouse Effect (GE) has been assumed to be well understood for over 150 years. GE is currently viewed as a radiative phenomenon caused by atmospheric infrared opacity, which in turn depends on the concentration of heat-absorbing trace gases such as CO_2, water vapour, methane, ozone and a few others. The atmosphere is mostly transparent to incoming shortwave radiation while absorbing a substantial amount of the outgoing (upwelling) long-wave flux emitted by the surface. This infrared absorption is thought to reduce the rate of Earth's cooling to Space, hence significantly raising the surface temperature above that of an airless environment such as the Moon. Thus, according to the current GE model, the atmosphere acts as a 'radiative blanket' that keeps the Earth surface sufficiently warm to allow the existence of liquid water and biological life on our planet. Hence, increasing the tropospheric concentrations of non-condensable greenhouse gases through fossil fuel burning would boost atmospheric optical depth and the absorption of thermal radiation leading to an enhanced GE and surface warming as a result. This concept forms the basis for present climate projections. However, mounting scientific evidence indicates that Global Circulation Models (GCMs) fail to simulate proxy-derived key features of past climates and observed temperature trends since 1993. The model-data discrepancy has grown to a level that warrants a re-examination of fundamental assumptions in the Greenhouse hypothesis. We present results from a novel mathematical/physical analysis of observed planetary data in the Solar System spanning a broad range of environments, which suggests that GE is not a radiative phenomenon, but a pressure-induced thermal enhancement independent of atmospheric composition. Our data-driven model shows that Earth's climate is part of a physical continuum in the Solar System governed by two primary factors: top-of-the-atmosphere solar irradiance and total atmospheric surface pressure. The model offers qualitatively new insights into the nature of climate forcings and their operational hierarchy. Our analysis suggests that forest-ecosystem management should not rely on warming projections by current climate models since these are likely algorithmic artefacts rather than descriptions of plausible future behaviours of the real system.

Key words: climate forcing, climate projection, planetary temperature model, pressure-induced thermal enhancement

THE POLICY BACK-CASTING PROCESSES AND ANALYSIS OF IMPLICATIONS OF INTEGRATIVE AND SEGREGATIVE MANAGEMENT APPROACHES TO FOREST LANDSCAPES PLANNING

Ivan Paligorov[1], Emil Galev[2*], Vasil Stiptzov[3], Stanislava Kovacheva[1], Elena Dragozova[1], and Ivaylo Ivanov[1]

[1]Faculty of Business Management, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mail: ipaligorov@abv.bg
[2]Faculty of Ecology and Landscape Architecture, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. [*]E-mail: emil.galev@abv.bg
[3]Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mail: vstiptzov@gmail.com

The article discusses some observations and problems related to the final work carried out in the INTEGRAL project funding from the European Community's Seventh Framework Programme under grant agreement n° FP7-282887 for Bulgarian case study areas Teteven and Yundola. Within the overall research design of the INTEGRAL project, an interdisciplinary framework for the combination of qualitative and quantitative back-casting methodology was developped. A certain part of the problem lies therein is to identify and propose ways and means of governance that have the potential to trigger substantial policy changes and human actions that promote integrated and future-oriented forest management in Europe. The other part of the activities are expressed in carrying out a quantitative evaluation of the suggested policy actions. The article presents the results of the backcasting process and the findings that have been made throughout the backcasting process in the case study areas Teteven and Yundola of the INTEGRAL project. Last but not least, the backcasting process integrates the assessments of Ecosystem Services that are expected to be realized given the outcomes of the backcasting workshops within the different scenario's, i.e. they are the product of interdisciplinary cooperation between experts from various professional fields.

Key words: decision support system, forest and forestry management, modelling.

BLACK LOCUST WOOD – PERSPECTIVE RAW MATERIAL FOR PRODUCING OF CHEMICAL PULP AND BIOETHANOL

Panayot Panayotov[1*], Ivo Valchev[2], Kancho Kalmukov[3], Momchil Panayotov[1], Stoyko Petrin[2], and Nikolay Yavorov[2]

[1]Faculty of Forest Industry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. [*]E-mails: ppanayotov45@abv.bg, ppanayotov@dir.bg
[2]Department of Pulp, Paper and Printing Arts, University of Chemical Technology and Metallurgy, 8 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria. E-mail: ivoval@uctm.edu
[3]Experimental Station for Fast-Growing Forest Species, 18 Nove str., 5250 Svishtov, Bulgaria. E-mail: kkalmukov@abv.bg

The potential of black locust wood (*Robinia pseudoacacia* L.) for producing of chemical pulp and bioethanol is investigated. Different branches of black locust growing in various habitats in Bulgaria have been analyzed and comparison has been made of their chemical composition and density. It has been established that the differences in the content of cellulose, lignin, pentosans and extracted substances in the respective branches are not high and are within the range of 10 % of the corresponding component. Hence the effect of the chemical composition on the pulp yield is relatively low. The determined differences in the density of the black locust wood branches exert comparatively greater influence on the productivity and efficiency of the pulping process. The application of black locust branches with high density will increase the capacity of the plant. It has been shown that *Robinia pseudoacacia* has the highest potential in Bulgaria for bioethanol production. The glucose yield after enzymatic hydrolysis of steam-exploded black locust is approximately higher in comparison with corresponding treatment of maize stalks, wheat straw and fast-growing poplar and willow. There are possibilities for plantation harvesting in Bulgaria of separate branches *Robinia pseudoacacia* for chemical pulp or bioethanol production.

Key words: bioethanol, chemical composition, chemical pulp, density, enzymatic hydrolysis, *Robinia pseudoacacia*.

STRUCTURE BY HEIGHT OF NATURAL SCOTS PINE STANDS

Rumen Petrin

Forest Research Institute – Bulgarian Academy of Sciences, 132 St. Kliment Ohridski blvd., Sofia 1756, Bulgaria. E-mail: lesni4eja2013@gmail.com

In the following study the structure according to heigth has been studyed of a total of 111 sample areas of natural middle-aged and mature Scots pine dendrocoenoses located in the Mountains Rila, Rodops and Sakar mountain. The purpose of this study is to have the height structure of natural Scots pine dendrocoenoses studied so that a model can be created of their amount and assortment. The size curves or the structure curves of the two main groups: middle-aged and mature natural Scots pine dendrocoenoses have been objects of the study. In the process of the study of the curve and more specifically the declivity, a special method developed by the Bulgarian taxation science was used – The Method of the Natural Indicators by Y. Duhovnikov. Three groups have been discovered according to the declivity: SLANTING curves that are typical for the dendrocoenoses with natural zero indicators /NZI/ of SHo≥1.1, SEMI-SLANTING, typical for the dendrocoenoses with $0.86 \leq SH_0 \leq 1.09$; and with STEEP curves with SHo≤0,85. The declivity of the curves of height are very important to the overall characteristics of increase and size because they are connected to the assortment and mass of the dendrocoenoses... For the two age groups were made two types of studies of the declivity in two cases – individually and altogether. After this study the results of distribution were the same for both scenarios. The results give a reason for the dendrocoenoses' structure according to height to be studied altogether using the method of natural indicators. The average curves of the normal indicators, an important indicator when using MNI (method of natural indicators), are presented as a result. A conclusion has been made which states that the height structure of natural Scots pine dendrocoenoses and also the models that lead their beginning from them, can be studied separately for the separate types of declivity of the height curves. The studies for height structure can be done regardless of the dendrocoenoses' age.

Key words: natural indicators, declivity of curves, tip of declivity.

FOREST ECOSYSTEM RESTORATION ON POST MINING SITES – CHALLENGE OF THE NEW CENTURY

Marcin Pietrzykowski

Department of Forest Ecology and Reclamation, Institute of Ecology and Silviculture, Faculty of Forestry, University of Agriculture in Krakow, Al. 29 Listopada 46, 31-425 Kraków, Poland.
E-mail: rlpietrz@cyf-kr.edu.pl

Post-mining landscapes are examples of a large scale transformation and human disturbance to ecosystem i are of worldwide interest and concern. In the world, coal and lignite still play important role in the energy mix. Large portion of post-mining sites are afforested. A main objective of forest restoration at post-mining sites is establishing a long-term sustainable ecosystem, which depends on adaptations of tree species to newly-formed reclaimed mine soils, which are characterized by highly changeable chemical and physical properties. Reclaimed Mine Soils (RMS) are characterized, as well, by large spatial variability and consequently changeable habitat conditions. Thus in recent years, interest in tree species selection and their adaptation to post-mining sites has grown. The work presents consequences of mining extraction for environment and reclamation managements, with special focus on diversity of mine sites and soil-substrates affected degree of reclamation difficulties. An example of soil reconstruction techniques across continents, variation of mine soils, site classification for forest management were discussed with connection to tree species response and selection in forest management on mine and industrial sites.

Key words: afforestation, mine soil, reclamation, stands, species selection, sustainability.

EFFECTS OF GIBBERELLIC ACID AND COLD STRATIFICATION ON SEED GERMINATION OF TWO *SORBUS* SPECIES

Elias Pipinis[1*], Elias Milios[2], Miltiadis Georgiou[1], and Pavlos Smiris[1]

[1]Laboratory of Silviculture, Department of Forestry and Natural Environment, Aristotle University of Thessaloniki, P.O. Box 262, 54124 Thessaloniki, Greece.
[*]E-mail: epipinis@for.auth.gr
[2]Department of Forestry and Management of the Environment and Natural Resources, Democritus University of Thrace, Pandazidou 193, 68200 Orestiada, Greece.

The present study aims at investigating the effects of gibberellic acid (GA_3) application and cold stratification on the germination of *Sorbus domestica* L. and *Sorbus torminalis* (L.) Crantz seeds. In particular, seeds of both species were treated with 500, 1000 and

2000 ppm GA_3 for 30 hours and were, subsequently, cold stratified at 3–5 ºC for 0, 1, 2 and 3 months. In addition, seeds from each species were only cold stratified for 0, 1, 2 and 3 months (control). In both species, non-stratified and 1-month cold stratified seeds, despite having been treated with GA_3 solutions, exhibited very low germination percentages (0.8–4.2 % for *S. domestica* and 0.0–1.7 % for *S. torminalis*). However, in control seeds and seeds treated with GA_3 solutions an increase in the cold stratification period from 2 to 3 months increased germination percentages significantly in both species. In *S. domestica*, after a 2-month period of cold stratification, the germination percentage of the seeds treated with 2000 ppm GA_3 (30.8 %) was significantly higher than that of control seeds (18.3 %). In 3 months of cold stratification, there were no significant differences in the germination percentages between control seeds and seeds treated with GA_3 solutions (87.5–91.7 %). In *S. torminalis*, the GA_3 application significantly improved the germination of 2 and 3-month cold stratified seeds. After a 2-month period of cold stratification, the germination percentage of seeds, which had been treated with 2000 ppm GA_3 (30.0 %), was higher than the germination percentages of the seeds which had been treated with 500 and 1000 ppm (15.8 and 14.2 % respectively). After a 3-month period of cold stratification there were no significant differences in the germination percentages between seeds treated with GA_3 solutions (88.3–91.7 %). The results demonstrated that the optimum germination percentages of *S. domestica* and *S. torminalis* were obtained after a 3-month cold stratification period. In both species, the application of GA_3 did not replace or shorten the required cold stratification period.

Key words: Seed dormancy, *Sorbus domestica*, *Sorbus torminalis*.

AFFORESTATIONS AND NATURE CONSERVATION IN BULGARIA

Emil Popov

Department of Forest genetics, physiology and plantation forests, Forest Research Institute – BAS, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria.
E-mail: emilpopov99@hotmail.com

Valuable information may be derived by assessing results from afforestation and reforestation activities undertaken under relatively favourable or extreme environmental conditions. The aim of this work is to elucidate some remarkable results of plantation forestry in Bulgaria and how they may serve us in a changing world. Biometric, statistical, inductive, and deductive methodological approaches were used. Speculations on the necessity to perceive forest plantations as a means of protecting the environment and forests on local and global scale are presented. Species for afforestation and reforestation are analysed in respect of various terrains, including devastated terrains. The number

of forest tree species is known to be highly variable not only regarding economically valuable traits such as growth in height, diameter and volume, but also in respect of their resistance towards unfavourable environmental conditions. The adaptiveness of forest vegetation to harsh conditions is particularly important in a changing environment. Examples demonstrating successful afforestation with indigenous as well as with introduced species aimed at restoration of forest vegetation in regions where this vegetation has been completely destroyed by anthropogenic activity are given. The public at large is not aware of the very significant contribution that forest plantations have: to mitigate changes, to reduce unemployment, to increase carbon sequestration, to protect land and water, to produce renewable energy, to assure sustainable timber production. Building a sustained afforestation programme and investing in science research and education for assessing the benefits of forest plantations is crucial. Not only would that prove highly valuable at present but also for future generations.

Key words: devastated terrains, environmental changes, plantation forestry.

INFLUENCE OF EDGE EFFECT ON PLANTS COMPOSITION AND DISTRIBUTION IN OAK FORESTS (KERMANSHAH FORESTS – IRAN)

Javad Eshaghi Rad[1*], Fozieh Soleimani[1], and Yahya Khodakarami[2]

[1]Department of Forestry, Faculty of Natural resources, Urmia University, P.O. Box 165, Sero blvd., Urmia, Iran. [*]E-mail: javad.eshaghi@yahoo.com[*]
[2]Agricultural and Natural Resources Research Center of Kermanshah province, P.O. Box 48331-67158, Keshavarz blvd., Kermanshah, Iran.

The aim of this research was evaluation of the influence of edge effect due to forest fragmentation on the plant species composition and distribution in oak forest of Kermanshah province (Iran). Three patches of oak forests stretched over the northern aspects of oak forests were selected with similar conditions slope and altitude. Vegetation sampling in each patch was conducted at 0, 25, 50, 100 and 150 meter along 3 transects located 200 m distances apart from each other (in total 45 sampling points). Cluster analysis and deterended correspondence analysis were applied to categorize and investigate the trend of vegetation variation in the different patches and indicator species analysis accompanied by Monte Carlo test were used to determine the characteristic species of each group. The results showed that in this area there were 115 plant species which belonged to 91genera and 25 families. Two categories including the forest edge samples group (zero and 25 m) and within forest samples group (50, 100 and 150 m) were separated which distance from the patch edge was the

most important factor of plant distribution. Characteristic species for the first group were: *Aegilops umbellulata, Alyssum meniocoides, Anthemis hyalina, Calendula persica, Echinops kermanshahanicus, Euphorbia macroclada, Gundelia tournefortii, Lens orientalis, Onobrychis lanata, Picnomon acarna, Sisymbrium damascenum, Tragopogon coelesyriacus, Verbascum pseudo-digitalis, Vicia assyriaca, Vicia narbonensis* and for the second group were: *Alyssum marginatum, Anagalis arvensis, Galium aparine, Geranium tuberosum, Phlomis persica*, *Scandix pecten-veneris, Stipa barbata, Taeniatherum crinitum, Ziziphora capitata, Crataegus azaralus*.

Key words: flora, forest edge, forest patches, fragmentation, *Quercus persica*, Zagros forests.

COMPARISON OF ORDINATION METHODS, PCA, DCA AND NMDS FOR THE VEGETATION ANALYSIS

Javad Eshaghi Rad[1*], Naghmeh Pakgohar[2], Abbas Banj Shafei[1], and Jalil Alavi[3]

[1]Department of Forestry, Faculty of Natural Resources, Urmia University, P.O. Box 165, Sero blvd., Urmia, Iran. [*]E-mail: javad.eshaghi@yahoo.com[*]
[2]Faculty of Natural Resources, Urmia University, P.O. Box 165, Urmia, Iran.
[3]Department of Forestry, Faculty of Natural Resources, Tarbiyat Modarres University, Emam Reza blvd., P.O. Box 14115-335, Nor, Iran

The aim of this paper is to investigate the ability of different methods widely used in indirect ordination analysis of vegetation. We studied *Pinus nigra* forest plantation with area of 9.2 hectares, located of Urmia airport (located in the Western Azarbayjan province, Iran). Nine 100 m^2 plots were set up in the study area randomly in 50*50 grid network and vegetation were recorded. In addition, three 100 m^2 plots were set up along a transect with 50 meter interval in control area in unplanted site near the study area. We used quantitative vegetation dataset of Urmia airport plantation. Estimate of percent cover of each plant species was recorded by using the Braun-Blanquet scale. The ability of three ordination techniques (Principal Component Analysis (PCA), Detrended Correspondence Analysis (DCA), Non-Metric Multidimensional scaling (NMDS)) were evaluated with different criteria including, Kaiser-Guttman, Eigen values greater than 0.4, final stress in NMDS ordination and Procrustean analysis. DCA had eigenvalues greater than 4.0, and the covered Kaiser-Guttman criterion with an axis, the final stress is less than 10 in NMDS ordination, but PCA had covered Kaiser-Guttman criterion with three axes. Procrustean analysis of all three datasets showed that the correlation between DCA and NMDS ordination methods were significantly higher compared to other pairs. Therefore, Detrended Correspondence Analysis and

Non-Metric Multidimensional scaling were suggested as appropriate indirect ordination method for vegetation analysis.

Key words: Iran, *Pinus nigra*, plant composition, Procrustean analysis.

CITIZEN SCIENCE APPLICATION FOR FORESTRY

Dmitry Schepaschenko[1,2*], Myroslava Lesiv[1,3], Steffen Fritz[1], Linda See[1], Anatoly Shvidenko[1], Christoph Perger[1], Florian Kraxner[1], and Maria Schepaschenko[4]

[1]International Institute for Applied Systems Analysis, Laxenburg, A-2361, Austria.
[*]E-mail: schepd@iiasa.ac.at
[2]Moscow State Forest University, Mytischi, 141005 Moscow, Russia.
[3]Lviv Polytechnic National University, 79013 Lviv, Ukraine.
E-mail: myroslava.lesiv@gmail.com
[4]Russian Institute of Continuous Education in Forestry, 141200 Pushkino, Russia.
E-mail: mariaschep@gmail.com

Citizen science and crowdsourcing applications have been growing fast recent years. Reasons for that are release technological innovations and willing of citizens to participate in scientific research to solve environmental issues. Technical background includes free access to the high-resolution imagery (e.g. presented in Google Earth); and mobile devices with their capabilities to take geo-referenced pictures, availability of sensors (e.g. gyroscope) and fast internet connection. Some citizen science applications have been relevant to forest. 1) Gather information from social networks for real time monitoring of disturbances (e.g. wildfire, flooding, and windbreak). People post unusual events and one can even draw the spatial extension of disturbances in high-populated areas. 2) Measure forest parameters (e.g. relative stocking and tree height) with mobile devices and upload this info together with geo-referenced photo to a web database. 3) Validation of land cover and in particular forest cover maps. IIASA has developed several applications in this area including the Geo-wiki.org portal, mobile applications (e.g. Geo-Wiki Pictures) and games (e.g. Crop capture). The team at IIASA runs regularly crowdsourcing competitions to encourage people to participate in the validation campaigns. Incentives for participation include prizes and co-authorship on publication outcomes. This work results independent validation of existing land cover and forest maps; production of hybrid maps with known uncertainty. A number of global and regional forest cover products are now available. However, these datasets often contradict one other and they are typically inconsistent with national statistics. In this paper we compared a number of the remote sensing products with a sample of high-resolution images provided by Google Earth and classified in the crowd-sourcing platform Geo-Wiki. We applied the method of geographically weighted regression

to estimate accuracy of the maps and generate a hybrid forest map. The method was applied globally (1 km resolution), for Ukraine (300 m and 60 m) and Moscow region (30 m). Independent validation shows that the hybrid products are better than any of the individual datasets. The hybrid maps present up-do-date and validated forest cover, which results effect of climate change, disturbances and management practice. The work was partly supported by FP7-MC-IIF grant (SIFCAS 627481).

Key words: crowdsourcing, disturbances, forest cover, monitoring, remote sensing.

CHROMOSOME NUMBERS AND SUPERNUMERARY (B) CHROMOSOMES IN POPULATIONS OF NORWAY SPRUCE FROM WESTERN RHODOPES, BULGARIA

Alexander Tashev[1], Tamara Sedelnikova[2*], and Alexander Pimenov[2]

[1]University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria.
E-mail: atashev@mail.bg
[2]V. N. Sukachev Institute of Forest SB RAS, Akademgorodok 50/28, Krasnoyarsk, 660036, Russia. [*]E-mail: tss@ksc.krasn.ru

Investigations on chromosome numbers in populations of Norway spruce (*Picea abies* (L.) H. Karst.) from Bulgaria have been conducted. Seeds from two populations of *P. abies* of Western Rhodopes (Drangov kamak and Charkovi livadi) located at the southern border of species range, and protected according to Bern Convention and EC Habitat Directive were collected for this study. Diploid set of 24 (A) chromosomes (2n = 2x = 24) was found in root meristems of *P. abies* from the two populations studied. Mixoploidy was found in some germinating seeds of *P. abies* both from Drangov kamak and Charkovi livadi populations: in separate metaphase cells triploid (2n = 3x = 36) and tetraploid (2n = 4x = 48) chromosome numbers were revealed, while the majority of cells had diploid chromosome number (2n = 2x = 24). Supernumerary (B) chromosomes (24 + 1–4B) belonged to either B1 (metacentric) and B2 (submetacentric) types were found in the metaphase cells in both *P. abies* studied populations firstly for the species. There with among germinating seeds with supernumerary chromosomes B1 type from Charkovi livadi was found in 93.3 % of cases, and from Drangov kamak – in 86.7 % of cases. The other cells with supernumerary chromosomes contained B2 type. The seeds from Charkovi livadi contained 0–4 B chromosomes, while these from Drangov kamak had 0–2 B chromosomes. Presence and occurrence of B chromosomes greatly varied among seeds from the two populations of *P. abies*. Along with B chromosomes, some chromosome rearrangements such as fragments and ring chromosomes were revealed in metaphase cells of *P. abies* from studied populations. Probably B chromosomes

occurrence in *P. abies* populations from Charkovi livadi and Drangov kamak growing at the southern border of species range is connected with adaptation of plants to the environmental conditions. A serious factor for induction of B-chromosomes and chromosome rearrangements could be the fact that the region of study was subjected to substantial anthropogenic pressure due to uranium extraction industry and natural radioactivity background.

Key words: chromosome rearrangements, diploid set of chromosomes, metaphase cells, mixoploidy, *Picea abies*.

IUFRO HISTORY AND RUSSIA

Valentin S. Shalaev[1*] and Victor Teplyakov[2]

[1]Institute for Forest System Researches, Moscow State Forest University, 1-st Institutskaya street, 1, Mytishchi-5, Moscow Region, 141005, Russia. [*]E-mail: shalaev@mgul.ac.ru
[2]Department of Forest Sciences, College of Agriculture and Life Sciences, Seoul National University, 1 Gwanak-ro, Gwanak-gu, Seoul 151-921, Korea (Rep).
E-mail: teplyakovv@gmail.com

The International Union of Forest Research Organizations (IUFRO) – is one of the oldest organizations, which coordinates the scientific study about nature and forest researchers in all diversity. IUFRO has more than 120 years history that it is very strange but IUFRO had no "formal" memorial until 2014. Only in 2014 the first monograph was published, which showed the process of IUFRO developing from idea to reality. Now IUFRO is the largest global forest researchers' network. This paper briefly shows the history of IUFRO, the main stages of its development, IUFRO congresses memorial, the role of Russian participation in IUFRO activities. They were the period of the Russian Empire/ The Soviet Union/Russian Federation. Russian forest sectors scientists, researchers, managers and specialists are mentioned in this presentation. IUFRO was founded in Eberswalde (Germany) in 1892 as the International Association of Forest Experiment Station. The First Congress-meeting was held in 1893 in Mariabrunn (Vienna, Austria). There were 15 officials from 5 countries: Austria, Germany, Switzerland, Hungary and Italy. But in 1896 at the II Congress in 1896 in Braunschweig (Germany) there were much more representatives from different countries. There were the participants: from Austria, Germany, Russia, Sweden and Switzerland. Russia became the IUFRO member in 1900. The Fifth Congress was held in 1906 in Stuttgart and Ravensburg (Germany). There were the representatives from 18 countries. It was the first visit for new members from Bulgaria and the North American United States. The VII Congress – was in 1929, in Stockholm (Sweden), There were 205 delegates from 31 countries, including the USSR. The X Congress was in 1948 in Zurich (Switzerland). There were

83 delegates from 16 European countries, from FAO and UNESCO. The XV Congress was in 1971 in Gainesville (USA). It was the first Congress organized outside of Europe, in North America and it became the World Congress. There were 681 delegates from 57 countries at that Congress. It was the time for radical reorganization of the Union. There were departments, subject, project, working groups and others. The XVIII Congress was in 1986 in Ljubljana (Yugoslavia), there were 2,247 registered participants from 73 countries, including 1876 reports. The XXIV IUFRO World Congress «Sustaining Forests, Sustaining People: The Role of Research» was held in 2014 in Salt Lake City (USA). 2,492 scientists, experts and nearly 700 students from 100 countries participating attended it.

Key words: stages of development, the Congress, the Russian representatives.

GROWTH AND REGENERATION OF MACEDONIAN PINE (*PINUS PEUCE* GRISEB.) IN BAVARIA AGAINST THE BACKDROP OF CLIMATE CHANGE

Martin Bachmann[1], Daniela Rommel[2], and Bernd Stimm[3*]

[1]Department for Food, Agriculture and Forestry, Ebersberg, Bahnhofstrasse 23, D-85560 Ebersberg, Germany. E-mail: martin.bachmann@aelf-eb.bayern.de
[2]Bern University of Applied Sciences, School of Agricultural, Forest and Food Sciences HAFL, Länggasse 85, CH-3052 Zollikofen, Switzerland. E-mail: daniela.rommel@bfh.ch
[3]Institute of Silviculture, Technische Universität München, Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, Germany. [*]E-mail: stimm@forst.wzw.tum.de

One strategy to mitigate the effects of climate change on forests in an uncertain future is the allocation of risks to a portfolio of different tree species. Since the beginning of 2009 a project of the Bavarian State Institute of Forestry give attention to the identification of warmth and drought tolerant tree species against the background of climate change. As an outcome of this process six potential non-native tree species have been selected for the establishment of species trials in Bavaria. Parallel to the establishment of young trial plantations one of them – *Pinus peuce* – could be analyzed in detail in 67 to 105 year old planted stands in Upper Bavaria and Upper Palatinate for complementing information. We aimed to determine previous growth and performance and tried to compare it with that of other tree species, e.g. Norway spruce, Scots pine, Eastern white pine, Douglas fir. For instance four small planted stands in the Forest Experimental Garden of Grafrath achieved a mean dbh of 26.8 to 43.8 cm, an average height of 24.1 to 28.4 m at a single tree volume of 0.7 to 1.8 m³. Due to drought stress, particularly during a period of increased temperature, the radial growth of *P. peuce* broke in considerably in the years 1976 and 2003, whereupon the species recovered quickly from the debilitation. As

a consequence of decreasing precipitation and high numbers of frost days in May *P. peuce* exhibited strong negative reactions in annual ring width. In general trees reacted positively to increasing mean annual temperature. Despite of a high volume production the results revealed several uncertainties about the suitability of *P. peuce* for South Bavaria. On the assumption of a further decrease in precipitation in the near future *P. peuce* is probably going to suffer increasingly from drought stress and is going to lose annual increment. Nevertheless the species seems to be qualified for afforestation in montane areas because of given proof of resistance against wind throw and snow break. The wood of *P. peuce* has manifold uses, particularly as cabinet-wood but can also be used in pulp and paper production.

Key words: forest transformation, growth trials, tree species selection.

CAN DISTURBANCE MANAGEMENT FOSTER BOTH BIODIVERSITY AND ECOSYSTEM SERVICES?

Dominik Thom[1*], Rupert Seidl[1], and Simon Thorn[2,3]

[1]Department of Forest- and Soil Sciences, Institute of Silviculture, University of Natural Resources and Life Sciences Vienna, Peter Jordan Strasse 82, 1190 Vienna, Austria. E-mails: dominik.thom@boku.ac.at*, rupert.seidl@boku.ac.at
[2]Bavarian Forest National Park, 2 Freyunger Str., 94481 Grafenau, Germany.
[3]Department of Ecology and Ecosystem Management, Technische Universität München, Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, Germany. E-mail: simon@thornonline.de

Disturbances are highly sensitive to changes in both climate means and extremes, making intensifying disturbance regimes one of the key challenges for forest management under climate change. Yet, a comprehensive understanding of disturbance impacts on ecosystem services and biodiversity is still lacking, hampering a science-based response to these changes in disturbance management. We here (i) review the impact of fire, wind, and bark beetles on biodiversity and ecosystem services to facilitate a broad understanding of disturbance effects, and (ii) highlight the effects of salvage logging and prescribed burning, two important approaches in disturbance management, in this context. We found that ecosystem services are mostly negatively affected by disturbance, while effects on biodiversity are predominantly positive. Our global meta-analysis suggests that neither prescribed burning nor salvage logging are suitable means to simultaneously enhance biodiversity and ecosystem services provisioning. While prescribed burning has an overall positive effect on biodiversity, it still affects ecosystem services negatively. Furthermore, salvage logged sites were not found to significantly differ from non-salvaged areas in terms of biodiversity and ecosystem services. To further elucidate this unexpected finding with regard to salvage effects on

biodiversity, we disentangled its impacts on 24 taxonomic groups. Our findings reveal large differences between these groups, ranging from significantly positive (e.g., on non-saproxylic beetles) to significantly negative (e.g., on epixylic lichens) impacts of salvage harvesting. We conclude that disturbance management activities such as salvage harvesting and prescribed burning should be carefully evaluated in the context of local sites and management goals, rather than being prescribed or condemned unreflectingly. More generally, a management that fosters disturbance resilience and recovery, e.g., through leaving parts of the landscape unsalvaged, while aiming to reduce disturbance frequency and severity – and consequently impact – might achieve a viable compromise between the positive and negative effects of forest disturbances.

Key words: bark beetles, fire, prescribed burning, salvage logging, taxonomic groups, wind.

ABOVEGROUND BIOMASS FOR NORWAY SPRUCE STANDS IN WESTERN BALKAN RANGE

Toma Tonchev[1*], Yavor Poryazov[1], and Violeta Dimitrova[2]

[1]Department Forest management, University of Forestry, 1797 Sofia, 10 St. Kliment Ohridski blvd, Bulgaria. [*]E-mail: toma_tonchev@yahoo.com
[2]Department Dendrology, University of Forestry, 1797 Sofia, 10 St. Kliment Ohridski blvd, Bulgaria.

The aim of this paper is to present the results of a case study of Norway spruce plantations in Petrohan training and experimental forest enterprise. The biomass estimation is based on two permanent and four temporary sample plots. The plant communities are determined by the phyocoenological releves. They are related to 9410 Natura 2000 habitat – Acidiphilous Picea forests of the mountain to alpine levels (Vaccinio-Piceetea), sub-alliance Abieti-Piceenion and the association is Picetum herbosum. The biomass is estimated for the individual tree components: stem bark, stem wood, dead branches, live branches, and leaves. Calculation of mean and current annual increment for aboveground dry matter is performed and Duhovnikov's "Analysis of stand" method is applied for the estimation of stand growth and yield. The results of study provides information for aboveground biomass prediction for whole spruce stands and contributes to the estimation of carbon pools in spruce ecosystems in Bulgaria.

Key words: Bulgaria, carbon pools, forest inventory, *Picea abies* (L.) Karst.

DYNAMIC GROWTH MODEL FOR RED OAK PLANTATIONS IN BULGARIA

Yavor Poryazov[1], Toma Tonchev[1*], and Rilka Bekyarova[2]

[1]Department Forest management, University of Forestry, 1797 Sofia, 10 St. Kliment Ohridski blvd, Bulgaria. [*]E-mail: toma_tonchev@yahoo.com
[2]State Forest enterprise Smolyan, 4700 Smolyan, 83 Bulgaria blvd, Bulgaria.

Red oak plantations in Bulgaria are distributed predominantly in the Eastern and Northeastern parts of the country. Site index tables used for their inventory are constructed by relative site index classes without taking into account the rate of growth. The aim of this paper is to present a dynamic stand growth model based on the Bulgarian "Analysis of a stand" (Duhovnikov, 1966, 1971) method. The input variables in this model are the rate of growth of main stand characteristics (mean/dominant height, average diameter, basal area per hectare, stem volume per hectare) and the rate of height growth of the mean sample tree at the age of 100. Applying the methodology the output of the model projects backwards the main stand characteristics and constructs dynamic yield tables for different rates of growth.

Key words: *Quercus rubra* L., site index, whole-stand model, yield prediction.

GHG EMISSIONS IN FIREWOOD SUPPLY CHAINS: THE CASE OF NORTHERN GREECE

Petros A. Tsioras[1*], Dionysios Bochtis[2], and George Banias[3]

[1]Laboratory of Forest Utilization, Department of Forestry and Natural Environment, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece. [*]E-mail: ptsioras@for.auth.gr
[2]Mechanical Engineering Division, Department of Engineering, Aarhus University, Inge Lehmanns Gade 10, Building 3210, 8000 Aarhus C, Denmark.
E-mail: dionysis.bochtis@eng.au.dk
[3]School of Economics, Business Administration and Legal Studies, International Hellenic University, 14th km Thessaloniki – Moudania, 57001 Thermi, Greece.
E-mail: g.banias@ihu.edu.gr

Firewood is a very important energy source for Greece. The goal of this study is to carry out an assessment of the energy requirements and carbon footprint of a firewood production chain in NW Greece. The specific supply chain refers to a company located in Grevena, which supplies chopped firewood to its retailers' network in Thessaloniki, 165 km away. The boundaries of the system have been defined and a Life Cycle Inventory (LCI) has been created. All activities, equipment and fuel consumption data have been

included in the LCI, with the wood harvesting and log processing data been collected by means of time studies. Truck transportation from the roadside to the firewood retailer in Thessaloniki was responsible for 54.45 % of the total energy expenditure. The energy input-output was 1:31.5 solely for the forest operations and it increased to 1:9.84 when all processes were included. The carbon footprint per functional unit has been estimated at 1.59 kg CO_2e per KWh of energy produced. The results suggest that the firewood supply chain in its present form constitutes a sustainable and environmentally friendly source of fuel, which can be further improved in terms of energy efficiency and GHG emissions.

Key words: biomass supply chain, carbon footprint, energy balance, Life Cycle Inventory.

WOODEN POLE PRODUCTION IN GREECE

Petros A. Tsioras*, Diamantis Liamas, Pavlos Efthymiou, Dimitrios Koutsianitis, and Elias Voulgaridis

Laboratory of Forest Utilization, School of Forestry and Natural Environment, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece. E-mails: ptsioras@for.auth.gr*; dliamas@for.auth.gr; pnefthy@for.auth.gr; koutsian@for.auth.gr; evoulga@for.auth.gr

Conifer species poles are widely used in Greece in power transmission and telecommunication lines. The aim of this study focuses on the estimation of the productivity rate of a wood harvesting system producing wooden poles. The study was carried out in a Black pine stand (*Pinus nigra* Arn.) in the Pindos mountainous area of Perivoli-Grevena, NW Greece. Data of time consumption have been collected, for all work phases involving felling and processing for a total of 62 trees harvested. Net hourly felling and processing productivity per productive man hour (PMH) of debarked poles was found 2.34 m^3/PMH, while it was reduced to 2.05 m^3/PMH when justified delays were included. The productivity was substantially higher when the poles were left with their bark on (9.44 m^3/PMH and 7.32 m^3/PMH with all justified delays included). The results suggest that debarking in the stand or in the upper landing is a very time consuming operation and its transferring to the wood industry site, for mechanical debarking, should be pursued. During this study, certain weaknesses have also been observed with respect to the level of professional competence of the existing workers, which inhibits a higher productivity rate, as well as less to the detrimental effects on the remaining stand. Rationalization of the wood harvesting system studied, in terms of economic and environmental efficiency, requires the employment of specialized vocational training to the forest workers of the area.

Key words: Black pine, debarking, productivity, time study.

This research has been co-financed by Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) – Research Funding Program: Thales. Investing in knowledge society through the European Social Fund. (Project title: Improvement of wood treatability in refractory to impregnation conifer species by surface drilling with laser – MIS377333).

CLIMATE-TREE RING WIDTH RELATIONSHIP IN A CORK OAK (*QUERCUS SUBER* L.) STAND IN SOUTH-EASTERN BULGARIA

Ivaylo Tsvetkov[1], Stefan Mirchev[2*], and Nikolay Zafirov[2]

[1]Forest Research Institute, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria.
[*]E-mail: tsvet_i@yahoo.com
[2]University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria.
E-mails: stemir_bg@yahoo.com; niki.zafirov@gmail.com

The core samples for dendrochronological analysis were taken from a pure cork oak stand near Parvomay village, South-Eastern Bulgaria. The sampled trees were between 40 and 50 years old. The radial growth trend was best described by simple regression analysis. Response function analysis of the mean index chronology identified both the monthly air temperature and precipitation as dominant climatic factors influencing radial growth of the cork oak trees. The growth of trees in these semiarid regions is frequently limited by the availability of water and the regression analysis primarily reflects this variable. Water stress during the summer seasons appeared to be the main growth limiting factor for the cork oak trees.

Key words: core samples, dendrochronology, monthly air temperature, precipitations, response function, water stress.

RESPONSE OF NON-TIMBER FOREST PRODUCTS (NTFPS) TO IMPACT OF CLIMATE CHANGE: A STUDY OF *IRVINGIA WOMBOLU* VERMOESEN

Agbaeze Umazi Udeagha[1,2,3*] and Enefiok Sunday Udo[2]

[1]Department of Agriculture, Hussaini Adamu Federal Polytechnic, Kazaure, Jigawa State, Nigeria. [*]E-mails: aumazi@yahoo.co.uk, uumazi@gmail.com
[2]Department of Forestry and wildlife, University of Uyo, Uyo, Akwa Ibom State, Nigeria.
[3]Nigerian Environmental Study Action Team, NEST House, 1 Oluokun Street, Off Awolowo, Bodija, Ibadan, Oyo State, Nigeria.

Non-Timber Forest Products (NTFPs) gathered from the forest and other natural ecosystem are vital for supplementing agricultural production by contributing to improve food availability, quality, nutrition and economy of households. However, the availability of these NTFPs could be seriously impacted by changing climate. Therefore, this study examined the perceived response of *Irvingia wombolu* fruits and kernels availability to impact of climate change in Cross River State, Nigeria. The survey data were collected from 200 households through a multi-stage sampling techniques using semi-structured questionnaire. Descriptive statistics and Likert-type scale were employed for data analysis. The results obtained showed that 91.5 % of the households perceived decrease in the availability of *Irvingia wombolu* fruits and kernels over the past 10 years due climate change impact. The results of Likert rankings shows that the response of *Irvingia wombolu* fruits and kernels to impact of climate change during phenological stages were significant, positive and high ($\overline{X}$ = 4.022) as this could cause a huge decrease in its availability, distribution and productivity, the coping strategies to stress of climate change were very low and not significant enough to encourage adaptation to climate change ($\overline{X}$ = 1.89). The study revealed that *Irvingia wombolu* fruits and kernels availability are threatened by climate change as the abundance decreases over time. Adequate attention is required in the formulation of policies and designing of strategies to encourage more domestication of *Irvingia wombolu* in private, public and communal lands in order to ensure its future prospects and contribution to household income.

Key words: availability, fruits, kernels, perceived, phenology, stress.

SEED QUALITIES AND SEED DORMANCY BREACKING OF SYCAMORE MAPLE (*ACER PSEUDOPLATANUS* L.) SEEDS

Lyubka Varbeva and Nasko Iliev*

Department of Silviculture, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mails: lubka.varbeva@gmail.com, ilievnasko@abv.bg*

Mature seeds of Sycamore maple have a physiological dormancy. Different studies suggest fall sowing or cold stratification for too different period from 3 weeks to 3 months. The aim of the study is to find optimal way for dormancy breaking in East South Europe conditions. They are tested variants fall sowing, spring sowing of stored in dry substratum (untreated) seeds and sowing after 1, 2, and 3 months cold stratification. The results showed that after 2 and 3 months cold stratification the seeds germinate in substratum (relatively 51.5 ± 4.2 % and 71.8 ± 2.8) and they become no useful for sowing. During the 1 month cold stratification in the substrate germinate only 7.0 % of seeds. The germination after fall sowing is 68.8 %. After spring sowing of untreated seeds and 1 month cold stratificated seeds the germination is relatively 82.3 % and 82.75 % (whiteout statistical significant difference). The height of seedlings was smaller after fall sowing – average 9.76 cm. The seedlings produced after spring sowing of untreated seeds had average height 12.3 cm. The best growing showed the seedlings after 1 month cold stratification – average 19.2 cm. The results bring to some conclusions. It is not recommended to store Sycamore maple seeds till spring in wet substrate because it has characteristics of cold stratification and lead to their early germination. The best way for seed dormancy breaking is 1 month cold stratification at 4 °C temperature. The germination dynamics show that stratification have to begin 45 days before the data of last spring frost and the sowing have to be done 15 days before the determinated date. Second variant is spring sowing of dry substrate stored seeds. In this case germination beginning is 25 days after the sowing and there is not danger of frost caused damages.

Key words: cold stratification, fall and spring sowing, germination.

DISEASES IN WILD-GROWING HONEY BEARING PLANTS IN LYULIN MOUNTAIN IN BULGARIA

Evgenia Velinova[1*], Yordanka Stancheva[2], and Alexander Tashev[3]

[1]Department of Dendrology, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. [*]E-mail: pancheva.evgeniya@gmail.com
[2]Department of Plant Protection, Faculty of Agronomy, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mail: agroforestry@abv.bg
[3]Department of Dendrology, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mail: atashev@mail.bg

The paper presents characteristics of the diseases in melliferous plants of the Bulgarian flora. The survey of the literature data revealed that there are more than 835 pathogens causing diseases in plants of interest. A particular attention is given to the results of investigation conducted in one Bulgarian area – Lyulin Mountain. Forty-six phytopathogens were identified, forty three of them being fungi and three – viruses. Most phytopatogens belong to the phyla Deuteromycota and Basidiomycota – represented by 15 species each. A full list of investigated species is presented. Phytopathogens as a group on wild-growing melliferous plants were analyzed for the first time.

Key words: melliferous plants, flora, phytopathogens.

THE EMBERGER INDEX AND ITS APPLICATION TO FOREST RESTORATION IN THE 21ST CENTURY

Federico Vessella[*], Erica Chiummariello, Francesco Angelini, Tatiana Marras, and Bartolomeo Schirone

AgroForestry, Nature and Energy Department (DAFNE), Università della Tuscia, Via S. Camillo de Lellis, snc, 01100 Viterbo, Italy. [*]E-mail: vessella@unitus.it

The Emberger Index is often used to characterize the climate of areas devoted to reforestation programs and forest/environmental restoration, because it indirectly summarizes evapotranspiration and draughtiness in a single parameter, thus it is a favourite tool especially in the Mediterranean environment. Despite its usefulness, the index is still based on 80 years old time series data, thus the updating of this explanatory variable related to species potential distribution is of the upmost importance, especially in relation with the global climate change. In fact, as a consequence of the recent changes in climate, many species might be affected in their occurrence, in terms of range variations. This study aims to forecast the spatial variation of the Emberger

Index envelope calibrated on a keystone species of the Mediterranean climate: cork oak (*Quercus suber* L.). For this purpose, we updated the index with the most recent data based on WorldClim datasource. Since the species shows a clear phylogeographical structure, previously detected with PCR-RFLP at 5 chloroplast loci, the investigation focused also at haplotype level. As a first step, the species actual distribution was used to estimate its ecological amplitude with respect to Emberger Index. Thereafter, populations grouped according the haplotypes were analyzed. Deciles were calculated as a measure of the species suitability related to Emberger. Basing on the "niche stability" assumption, we forecast the present Emberger array by means of 3 climate projections (CCSM4, MIROC5, HadGEM2-ES) for 2 greenhouse gas scenarios (RCP 4.5, RCP 8.5), and 2 periods (average of 2041–2060, and 2061–2080). Results point out new suitable areas especially in the East Mediterranean, where the species is presently absent, and a northward range shifting along the 21st century. At haplotype level, we might assess a correlation between the geographical extent of each genetic group and the climatic features in terms of minimum temperature and Emberger Index. In all cases, results showed the Emberger Index, in couple with minimum temperature, as a promising synthetic approach for those foresters facing the present and future reforestation challenges. Novel involvements and debates might arise about the effect of climate change on forest conservation, restoration and management.

Key words: climate change, ecological modelling, *Quercus suber*, reforestation.

STRUCTURE AND FUNCTIONAL DIVERSITY OF SOIL MICROBIOTA IN NORTH-TAIGA SPRUCE FORESTS OF THE EUROPEAN NORTH-EAST

Elena M. Lapteva, Yulia A. Vinogradova*, and Yury V. Kholopov

Soil Science Department, Institute of Biology Komi SC UrD RAS, 28 Kommunisticheskaya str., 167982 Syktyvkar, Russia. *E-mail: vinogradova@ib.komisc.ru

The territory of the European North-East is dominated by spruce (60.2 %) forests. They grow on different-type podzolic and boggy-podzolic soils underlaid by loam. The present work aims at surveying structure and some functional characteristics of microbial complexes from podzolic and boggy-podzolic soils under different-moistured north-taiga spruce forests. Soil samples were taken from upper organic (O-horizon) and mineral (EL(h)g-horizon) soil horizons. Number of bacteria and fungal spores, length of mycelium and a fungi/bacteria microbe biomass ratio were determined by the method of luminescent microscopy. Functional status of microbial communities was accessed using the method of multi-substrate testing. Soil microbiota in different-moistured

spruce north-taiga forests preferably concentrate in forest litter horizons. Lower lying mineral horizons decrease in number of bacteria by 5–41 times and in number of fungal spores by 4–6 times. Biomass of microbial communities is structurally dominated by mycelium of microscopic fungi (85.6–93.6 %). Soil microbe communities in green-moss and long-moss spruce forests have similar and in some cases statistically equal parameters as number of bacterial cells and fungal spores, length of fungal mycelium, biomass of bacteria and fungal mycelium. Soil in sphagnum spruce forests differs from soils at the other two key plots by a sharp decrease in number and biomass of bacterial cells and an increase in total number of fungal spores, length of fungal mycelium and fungal biomass. According to the multi-substrate testing results, the most stable and soil quality favorable microbial community develops in organic soil horizons under green-moss spruce forests. Soil bogging in spruce forests lowers functional activity of soil microbiota. Higher moisture content decreases activity of alcohol-assimilating microbiota and increases assimilation of aminoacids. Microbe communities at excessively moistured soils do not practically consume such aminoacids as arginine, asparagine, valine, and serine. Soil microorganisms in green-moss spruce forest are highly diverse (the Shennon index of 4.4–49). It is 3.0–3.8 for boggy spruce forests. Mineral soil horizons for all studied soils have a lower biodiversity index (by 1.1–1.3 time). The *d* parameter responsible for stability of soil microbiota and the *G* integral index characterizing its well-being evidence a non-stable and unwell status of microbe communities. Only one horizon, i.e. forest litter of gley podzolic soil under green-moss spruce forest, can be considered a well-doing microbial system.

Key words: forest soils, microbe biomass, microbe communities, multi-substrate testing, taiga forests.

UNDERSTANDING OF ECOSYSTEM FUNCTIONING AS A PREREQUISITE FOR ECO-COMPATIBLE REFORESTATION OF DEGRADED AREAS WITH NATIVE SPECIES – A CASE STUDY FROM THE ANDEAN ECUADOR

Michael Weber*, Bernd Stimm, Patrick Hildebrandt, and Reinhard Mosandl

Institute of Silviculture, TUM School of Life Sciences Weihenstephan, Technische Universität München, Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, Germany.
*E-mail: m.weber@forst.wzw.tum.de

Worldwide reforestation activities on degraded land are still predominantly based on few well known plantation tree species. However, eco-compatible silvicultural concepts for the reforestation of degraded areas in regions with high biodiversity require a deep

understanding of ecosystem functioning and biodiversity. Using a case study from Ecuador we show that the development of silvicultural concepts for reforestation with native species has to go hand in hand with the generation of fundamental ecological knowledge about tree species traits and requirements, the consideration of natural forests as source of forest reproductive material as well as institutional capacity building and training of local experts. We present a conceptual framework based upon results from analyses of biodiversity and phenological patterns in a pristine forest, from nursery experiments and from reforestation trials.

Key words: biodiversity, forest reproductive material, natural forest management.

DENDROCHRONOLOGICAL ASSESSMENT OF CLIMATIC AND ANTHROPOGENIC INFLUENCES ON URBAN FOREST IN BULGARIA

Nikolay Zafirov*, Stefan Mirchev, and Radostina Schivatcheva

University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria.
E-mails: niki.zafirov@gmail.com*; stemir_bg@yahoo.com; joytinas@hotmail.com

The results of long-term dendrochronological investigation of planted urban forests growth and the impact of climatic and air pollution factors on them in the King Boris' Park, Sofia, are presented. Insufficient aeration of Sofia valley, presence of a number of enterprises, emitting enormous amounts of polluting agents, and increased traffic cause formation of fogs and concentration of toxic gasses, dust, smoke and soot in this area. The dynamics of the annual radial increment of the trees is influenced by the main climatic parameters (air temperature and precipitation) as well as the environmental pollution. Attention was concentrated on assessment of the joint impact of climatic factors and anthropological pollution on pine and oak stands. The results of the climate response models show the difference of the air pollution and natural factors impact on the studied pine and oak stands.

Key words: air temperature, oak, pine, polluting agents, precipitation, radial increment.

RESEARCH OF LANDSCAPES IN LANDSLIDES TERRAINS IN MELNIK REGION USING A LONG-DISTANCE METHOD

Dobrinka Zakova-Aleksandrova

University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria.
E-mail: dobrinka.zakova@gmail.com

Three landslides are object of the present study. It has been made a characteristic of the landslides terrains which includes a longitudinal section of the landslide surfaces and the watercourses they adjoin with. On the basis of landscape-ecological approach it was made a map of the landscapes, including three types of landscapes – forests, meadows and rocks. It was traced the evolution of landscapes in different parts of the landslides. It has been proposed a sign for the detection of landslides on the basis of a topographic map and color photo plan.

Key words: landscapes, landslide, range of erosion.

CURRENT STATUS AND PERSPECTIVES OF FOREST SEED ORCHARDS IN BULGARIA – LOOK BACK AND LOOK FORWARD

Velichko Gagov[1], Petar Zhelev[1*], and Ivan Evtimov[1]

[1]University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria.
E-mails: abies@abv.bg; zhelev@ltu.bg[*]; i_evtimov@abv.bg

The report presents a survey on the history and development of seed orchard establishment in Bulgaria. Main achievements, experience and lessons learned are presented and discussed. A comparison was done between the generative and clonal seed orchards, their advantages and disadvantages. A brief survey of Bulgarian experience with different seed orchards of different species was done. The results revealed that seed orchards in Bulgaria have been established mostly for coniferous species, but there are some seed orchards, however, very few, for broadleaves. A particular reference is given to the only one second-generation seed orchard in Bulgaria – the one of Silver Fir. The future of seed orchard is discussed in the light of global and local environmental changes and in the view of decreased amount of afforestations in Bulgaria.

Key words: genetic gain, seed production, tree breeding.

POSTER PRESENTATIONS

FLORISTIC STUDIES IN SLIVENSKA MOUNTAIN (EASTERN STARA PLANINA)

Alexandra Alexandrova*, Alexander Tashev, and Marius Dimitrov

Department of Dendrology, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., Sofia 1797, Bulgaria. *E-mail: a.v.alexandrova@abv.bg

The study of biological diversity is an important part of the activities related to environmental conservation. This is particularly relevant in the observed climate changes and changing social mind of the inseparable link between man and nature. The present study focused on the higher flora of Slivenska Mts (Eastern Stara Planina). A list of wild-growing plants elaborated is based on field studies by the method of botanical trips, parallel to the study of plant community during 2010–2014 and literature data, which was published in scientific surveys. The list comprises 1108 species belonging to 445 genera and 95 families, of 4 divisions. The systematic structure of the local flora was presented and a comparative analysis was made with the flora of Bulgaria and that of the Central Balkan National park. The division Magnoliophyta was the one represented the best – 1084 species, followed by the division Polypodiophyta with 16 species, Pinophyta – 5 species and Equisetophyta – 3 species. The richest families were Asteraceae (132 species), Poaceae (99 species) and Fabaceae (97 species). The most numerous genera were *Carex* (22 species), *Trifolium* (21 species) and *Centaurea* (17 species). Species' distribution by biological types and life forms was analyzed and biological spectrum of the flora was presented. According to their biological type most species are perennial herbaceous plants – 688 species, followed by annual herbaceous plants – 191 species. In biological spectrum hemicryptophytes dominate – 52.7 % from all species, followed by terrophytes – 17.2 % etc. The species with a Mediterranean component had the highest participation ratio of the floristic elements, followed by those of European origin. The study of plant community will be continued and the list of species will be completed in the project „Study of flora and vegetation of Slivenska Mts – stage I", financed by the University of Forestry.

Key words: biological diversity, biological type, life form, floristic elements, systematic structure.

DYNAMICS OF GAS-EXCHANGE WITHIN THE CROWN OF NORWAY SPRUCE (*PICEA ABIES* KARST.)

Svetoslav Anev* **and Nikolina Tzvetkova**

Department of Dendrology, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mails: svetoslav.anev@gmail.com*; nikolina_tzvetkova@mail.bg

Gas exchange and water relations were studied with respect to branch position in the crown of 37-year-old Norway spruce (*Picea abies* Karst.) tree, grown as forest plantation in the West Balkan Mountain. The needles of the middle-crown branches showed significantly higher rate of net photosynthesis compared to the upper and lower crown. The rate of transpiration and values of vapor pressure deficit gradually decreased to the upper-crown branches. The highest water use efficiency was established for the needles from the top of the crown. Variation in gas exchange and water relations with respect to crown position showed that branches growing at the crown base had diminished adaptive capacity than branches located at the top of the tree. The results of the study may serve as a theoretical basis for applying of precise silvicultural approaches in the forest practices, through better understanding of the physiological mechanisms for branch self-pruning.

Key words: photosynthesis, physiological mechanisms, transpiration, water use efficiency.

THE PLANT COMMUNITIES OF *SIDERITIS LANATA* L. IN SOUTH-WESTERN BULGARIA

Ina Aneva[1*], Petar Zhelev[2], Stoyan Stoyanov[1], and Lyuba Evstatieva[1]

[1]Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Acad. G. Bonchev Street, block 23, 1113 Sofia, Bulgaria. *E-mail: ina.aneva@abv.bg
[2]University of Forestry, 10 St. Kliment Ohridski Blavd., 1797 Sofia, Bulgaria. E-mail: zhelev@ltu.bg.

Sideritis lanata is a rare species important from nature conservation point of view. We present results of a study on plant communities of the species in its natural localities in Bulgaria situated only in south-western part of the country. Rich floristic composition was found in the natural habitats of *S. lanata*, including several rare and endemic species. Current status of the species and its natural habitats are discussed in the light of plant biodiversity conservation.

Key words: conservation, natural habitats, rare species.

RECLAMATION, LANDSCAPE DESIGN AND RECREATIONAL OPPORTUNITIES OF QUARRIES

Rossitsa Petrova[1], Atanas Kovachev[2], and Svetlana Anisimova[3*]

[1]Department of Soil Science, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mail: rpetrova_fri@yahoo.com
[2]Department of Park and Landscape Design, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mail: atanas_kovachev@mail.bg
[3]Department of Park and Landscape Construction, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. [*]E-mail: sanisimova@mail.bg

The report presents a case study of the rehabilitation of Chepintsi Sand and Gravel Quarry_in Sofia Region, Bulgaria, after technical and biological reclamation and landscaping. The plan for biological reclamation and landscape design has been made after a thorough assessment of the specific ecological conditions of the extraction site. The spatial design of the vegetation corresponds to the wide variety of recreational uses. Low-impact recreational activities requiring facilities that place minimal stress on the environment and meet a wide range of community needs, such as camping, picknicking, observing and photographing nature, wildlife education, walking, jogging, cycling, fishing and boating, are provided.

Key words: biological rehabilitation, gravel extraction, landscaping, recreation.

DISTRIBUTION SURVEY ON *TULIPA URUMOFFII* HAYEK ACROSS CHEPAN MOUNTAIN (WESTERN BALKAN) AND SPATIAL DATA ANALYSIS IN GIS ENVIRONMENT

Alexander Tashev, Maria Asenova[*], and Pavel Pavlov

Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., Sofia 1797, Bulgaria. E-mails: altashev@abv.bg, m_asenova@abv.bg[*], pavelppj@googlemail.com

The aim of the paper was to study the distribution of *Tulipa urumoffii* Hayek in Chepan Mountain (Western Stara Planina) in order to promote and make more efficient the conservation and monitoring of its populations. The localities of *T. urumoffii* in Chepan Mountain were mapped by GPS measurements on the field. A graphics database included vector and raster data of the localities and can be used in GIS environment. The populations of *T. urumoffii* were analysed spatially using GIS software package MapInfo Professional. The data were organized in electronic passports which include characteristics of the habitats and floristic composition of communities of *T. urumoffii*.

The current status of populations was evaluated and a prediction of the future state of the localities was done. User-friendly application for analysis and browsing of data was created via GIS tools and will be used to prepare a proposal to declare Chepan Mountain as protected area.

Key words: Chepan Mountain, database, information technologies, locality, *Tulipa urumoffii*.

ASSESSMENT OF SOME SUSTAINABILITY INDICATORS FOR BLACK PINE (*PINUS NIGRA* ARN.) PROVENANCE TRIALS IN PETROHAN TRAINING AND EXPERIMENTAL FOREST RANGE, NORTH WEST BULGARIA

Milko Milev and Alexander Bardarov*

Department of Silviculture, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mails: m_milev@abv.bg; a.bardarov@pdm-services.eu*

A Black pine provenance test was established in 1978 in North West Bulgaria to study the hereditary potential of selected offspring of some of the most valuable populations of the species in Bulgaria. Given the planting scheme of 2×2 m, 13 provenances, represented by the individual generative offspring of 28 plus trees and 12 provenance aggregations are assessed through three sustainability indicators including survival rate, quality of stems and general health status. At the age of 36, the average survival of the plantation is 68 %, varying between 38 % and 92 % for the different plots, without specific linkage to the altitude of origin of the latter. The impacts of wet snowfalls causing different types of curvatures play a primary negative role where comparative data of consecutive studies show that once affected by the snow, the sustainability of the trees deteriorates and results in a greater mortality afterwards. Among the important factors which impact survival is the growth competition although the planting scheme used provides relatively good growing space by this age. The most significant losses however had been endured during the early life of the plantation. The field data reveals that there are no definite evidences, supported statistically, on the influence of the provenance on mortality, quality and general health of the stands. This prompts that the main factors impacting sustainability are rather related to competition, individuality or notably the specific micro conditions within the site, than the geographic remoteness of the origin. *P. nigra* is sufficiently plastic and the represented populations are ecologically homogenous. Thus, the considerations on the provenance selection in afforestation practices may not have such a significant role and visible effect within the established plantations. A possible reason for this is that the nature conditions of the specific site, although outside

the natural range of distribution of the species, are relatively favorable but nowhere near the range limits for its survival. A more distinct impact of the geographic origin and the use of enhanced reproductive material (from the best populations and their plus trees) could be expected with regard to growth and productivity.

Key words: hereditary potential, impact, origin, plantation.

CHANGES IN THE COMPOSITION OF THE RAINFALL FLUXES PASSED THROUGH THE CROWNS OF BLACK PINE, ATLAS CEDAR, COMMON OAK AND BLACK LOCUST

Maria Broshtilova* **and Kostadin Broshtilov**

Oak Forest Experimental Station, 8008 Burgas, Bulgaria. E-mails: mbroshtilova@abv.bg*; kbroshtilov@abv.bg

The rainfall amount and its chemical composition were studied in the period 2009-2013, in the Pismenovo dendrarium situated close to Black Sea coast (Tsarevo State Forestry Service). The results showed that Black pine (*Pinus nigra* Arn.) crowns capture 29.2 % of the total rainfall amount at open field. The same percentage in Atlas cedar (*Cedrus atlantica* Manetti) was 34.4 %, in Common oak (Q*uercus robur* L) – 6.5 %, in Black locust (*Robinia pseudoacacia* L.) – 23.3 % and the throughfall in the 75-year old coppice oak forest was 15.8 % The pH value of the throughfall and that of rain water at open field had acid to slightly acid reaction, and the acidity increased during the winter. The lowest values of pH were measured in the water passed through Black pine crowns, and the highest ones – in the water passed through the crown of Black locust. Most nitrate ions were registered in the throughfall fluxes of Black pine. Most ammonium ions were detected in the throughfall fluxes of the 75-year old coppice oak forest, and chloride ions – in the throughfall of Atlas cedar. The content of Calcium and Magnesium increased in the throughfall increased in comparison to that measured in open field fluxes. The highest content of these two elements was recorded in the throughfall of Black locust.

Key words: nitrate ions, ammonium ions, chlorides, canopy, dendrarium, pH.

DYNAMICS OF MACROELEMENTS IN THE LEAVES OF TREE SPECIES GROWING IN PISMENOVO DENDRARIUM

Maria Broshtilova* **and Kostadin Broshtilov**

Oak Forest Experimental Station, 8008 Burgas, Bulgaria. E-mails: mbroshtilova@abv.bg*; kbroshtilov@abv.bg

The study took place in the period 2008–2012 in Pismenovo dendrarium, situated in the peripheral sub-region of Strandzha Mountains (South-eastern Bulgaria). Nitrogen and macroelement contents were examined in the leaves of 21–25-year old trees belonging to the following species: *Pinus nigra* Arn. ssp. *austriaca* Höss, *Pinus nigra* Arn. ssp. *laricio* Poiret, *Cedrus deodara* Loud., *C. atlantica* Manetti, *C. libani* A. Rich., *Cupressus semepervirens* L., *Quercus petraea* (Matt.) Liebl. (3 provenances), *Q. robur* L. (4 provenances), *Q. pubescens* Willd., *Q. rubra* L., *Q. suber* L., *Q. harwissiana* Stev., *Q. frainetto* Ten., *Fagus silvatica* L., *F. orientalis* Lipsky and *Tilia tomentosa* Moench. Nitrogen content in the leaves of most deciduous species was the highest in May, maintaining comparatively high values in June and gradually lowering in the next months until the end of vegetation period. P_2O_5 content had its maximum value in the summer months, keeping relatively high values until the end of the vegetation period. K_2O concentration in the leaves of most species was the highest in August. Ca and Mg content gradually increased from the beginning to end of the vegetation period. N, P_2O_5 and K_2O content in the coniferous species was significantly lower as compared to the one in the leaves of the deciduous species, which makes the latter ones more tolerant to soil fertility. Of conifers, the lowest concentration of these substances was recorded in the needles of the Atlas cedar. In broadleaved species the highest content was measured in *Tilia tomentosa* and *Q. hartwissiana* and the lowest one – in the leaves of the Cork oak. There were also differences among the provenances within a species. No significant differences in Ca and Mg content were found between the coniferous and broadleaved species, but in needles of Cedar species it was about 2 times higher than that in Black pine needles.

Key words: calcium, coniferous species, deciduous species, magnesium, nitrogen, phosphate, potassium.

SHOOT REGENERATION ABILITY OF WILLOW CLONES IN BIOMASS PLANTATIONS

Aneliya Dimitrova*, Kancho Kalmukov, Ilka Yonovska, and Miroslav Mikov

Experimental Station for Fast-Growing Forest Species, 18 Nove str., 5250 Svishtov, Bulgaria. E-mails: elina04@abv.bg*, kkalmukov@abv.bg, iyonovska@mail.bg, mmikov2008@gmail.com

The study investigates the shoot regeneration ability of ten willow clones in a test sample planted in the same initial density scheme (2.0 × 0.30 m.).The trees were planted in lots with identical soil characteristics on the second terrace of the Danube river. The soil is Haplic Kastanozem with alkalinity (pH) between 7 and 8 and underground water below 8 m. The climatic conditions are typical for the continental climate of Northern Bulgaria. Development of new shoots was recorded in three consecutive years – from the seventh to the ninth year of growth of the trees. The degree of preservation of the coppiced stumps, the number of shoots and their biometric data (height, stem diameter, weight in fresh and absolute dry condition) as well as their health status (live or withered) were recorded and compared. The results show that the shoot regeneration ability and the productivity of the various clones depend on the climatic conditions and the age of the trees. This shows that certain clones are more suitable for biomass production depending on the type of wood needed and the specific soil and climatic conditions of the designated planting area.

Key words: grow, new shoots, soil characteristics, yield.

NATURAL PATHOGENS ON TWO FOREST INSECTS IN BULGARIA

Danail Takov[1], Danail Doychev[2*], Daniela Pilarska[1], and Slavimira Draganova[3]

[1]Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, 1 Tzar Osvoboditel str., 1000 Sofia, Bulgaria. E-mail: dtakov@yahoo.com; dpilarska@yahoo.com
[2]University of Forestry, 10 Kl. Ohridski blvd., Sofia 1797, Bulgaria. *E-mail: doychev@abv.bg
[3]Institute of Soil Science, Agrotechnologies and Plant Protection, 7 Shosse Bankya str., 1080 Sofia, Bulgaria. E-mail: sdraganova19@gmail.com

Complementing the knowledge about insect biodiversity in forest and agricultural cenoses is associated with more intensive research on their entomopathogens as natural regulators of pest population density and possible control. Specimens of two forest insects *Pityogenes chalcographus* (L.) and *Attelabus nitens* (Scop.) were collected from two localities in the Western Rhodopes and were analyzed for the presence of

pathogens. Beetles of *Pityogenes chalcographus* (506 induviduals) were collected in July and August 2011 from attacked Norway spruce (*Picea abies* (L.) H. Karst.) trees in Beglika site. Microsporidium belonging to genus *Nosema* was detected in the fat body of the bark beetle. The pathogen was established after dissection of each host in laboratory under stereoscope and observation of the internal organs under light microscope. The prevalence of *Nosema* sp. reached only 1.2 %. The spores were oval and measured 2.38 μm (1.99–2.85) × 4.71 μm (3.71–5.61). The ultrastructural investigations of this microsporidium revealed internal structure typical for genus *Nosema* with binuclear sporogonial stages and spores. The nuclei were in diplokaryotic arrangement. The polaroplast was lamellar and the polar filament isofilar with 15–16 coils, situated in one row. For the precise species identification molecular analyses are needed. *P. chalcographus* is a new host for the microsporidium *Nosema* sp. Specimens of the oak leaf-roller *Attelabus nitens* (37 individuals) were collected on *Quercus petraea* (Matt.) Liebl. in June 2013 near to Yundola Vill. Dead insects with symptoms of mycosis were placed in a humid chamber for sporulation of the observed fungal pathogens on the cadavers. The pathogens were isolated into pure cultures on Sabouraud dextrose agar and were identified according to morphological characteristics as *Beauveria bassiana* (Bals.) Vuill. Conidia and conidiogenous cells were observed in smears stained with methylen blue and in durable specimens with lactophenol and aniline blue using a transmission interference microscope. The fungus *B. bassiana* was found in 62 % of the collected oak leaf-roller specimens. This is the first report of a mycosis found in adults of *A. nitens*.

Key words: *Attelabus nitens*, *Beauveria bassiana*, Coleoptera, entomopathogenic fungi, *Nosema*, *Pityogenes chalcographus*.

THE MANAGEMENT OF RIPARIAN FORESTS IN PROTECTED AREAS IN CENTRAL GREECE, THE CASE OF SPERHEIOS AND PINEIOS RIVER

Georgios Efthimiou

Department of Forestry & Natural Environment Management, Technological Educational Institute of Sterea Hellas, 36100 Karpenisi, Greece. E-mails: efthimiou@teiste.gr, gefthi@yahoo.gr

The riparian forests are among the most important ecosystems in ecological value of protected areas. Human activities directly or indirectly act on them, to a degree that can degrade and reduce significantly. Each degradation or disruption of natural ecosystems directly or indirectly leads to effects and climate change phenomena. In recent years,

with the designation and protection of areas of the Ramsar Convention, the Natura 2000 areas and the institutional designation of protected areas, there has been increased interest in the future and management of riparian forests. The purpose of this research is to study, record and present the timeless management of riparian forest ecosystems, in two selected protected areas, Spercheios and Pineios rivers. The riparian forests of these two areas belong to the European ecological network Natura 2000. It is a matter of riparian ecosystems that pass through or near large urban centers and many villages with intense anthropogenic primary activity. The aim of our research is to record problems and anthropogenic stresses on riparian forest ecosystems in both areas and to present the temporal application of management measures and techniques. It is given suggestions and remedies, conservation and recovery of riparian forests in two selected protected riparian areas of central Greece.

Key words: anthropogenic influences, management, Natura 2000, Pineios, riparian forest, Spercheios.

THE EFFECT OF GREEN SPACES STRUCTURES ON URBAN HEAT ISLANDS – CASE STUDY: KARAJ CITY, IRAN

Fereydoon Taheri Sarteshnizi[1], Jahangir Feghhi[1*], Afshin Danehkar[2], and Sahar Fatehi[3]

[1]Department of Forestry and Forest Economics, Faculty of Natural Resources, University of Tehran, Karaj, Postal code: 4111, Iran. E-mails: f_taheri1390@yahoo.com; jfeghhi@ut.ac.ir*
[2]Faculty of Natural Resources, University of Tehran, Karaj, Postal code: 4111, Iran. E-mail: danehkar@ut.ac.ir
[3]Watershed, Azad University, Science and Research Unit, End of satari highway, Azad University Square, College of Agriculture, Tehran, Postal code: 14515-775, Iran. E-mail: fatehisahar@yahoo.com

Affected by environmental conditions, temperature is the most important climatic factor in urban areas. One of the key consequences of urbanization on the environment is Urban Heat Island (UHI). Recognizing the effects of landscape patterns on UHI is critical for enhancing the environment and sustainability. Landsat 5 TM images acquired in 2009 were used to estimate Land Surface Temperature (LST) and also land use map prepared in 2009 was used to assess the urban green spaces structures. The purpose of this study is assessment the effect of urban green space structures on LST. After dividing the study area into units (each of them is 150 ha), quantification of green spaces (patches) structures was done by the "moving window" technique (using FRAGSTATS). In this regard, metrics related to surface, density, shape, richness, diversity and distance among patches in 2 classes of green spaces (tree and non-tree covers) were calculated and

average temperature in each unit was measured. Results demonstrate that there is a strong and significant relationship between each measured metrics at class level and landscape. This relationship is stronger for green spaces with tree cover in comparison to green spaces with non-tree cover. Also, there is a stronger relationship between metrics related to surface and density in the class of green spaces with tree cover and average temperature in compared to other metrics.

Key words: FRAGSTAS, landscape ecology, urban green space, Metric.

ASSESSING THE CONSERVATION STATUS OF FOREST HABITATS IN PROTECTED AREA "KAMCHIYSKA AND EMENSKA MOUNTAIN"

Georgi Hinkov[1*], Emil Popov[2], and Georgi Erbakamov[3]

[1]Department of Silviculture and Management of Forest Resources, Forest Research Institute – BAS, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria. [*]E-mail: georgihi@abv.bg
[2]Department of Forest Genetics, Physiology and Plantation Forests, Forest Research Institute – BAS, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria.
E-mail: emilpopov99@hotmail.com
[3]Forest Seed Control Station, 28 Slavyanska str., 4000 Plovdiv, Bulgaria.

Protected area "Kamchiyska Emenska Mountain" BG0000133 covers most of the eastern parts of the Balkan Mountains. It is representative of the forests in the Eastern Balkan Mountains and partly of the area of Northern Strandzha Mountain. An analysis of the state and conservation status of forest habitats 9180*, 91E0*, 91F0, 91H0*, 91G0*, 91M0, 91Z0 and 91S0*, has been made as a standardised methodology was implemented. Habitat 91M0 has the highest prevalence in the area and is followed by 91G0* and 91S0*. All forest habitats listed in the Standard form of the protected area have been set out. The overall assessment of all forest habitats, with the exception of 9180*, 91S0* and 91Z0, shows bad, unfavourable conservation status (more than nine parameters have such an assessment for each habitat). This is due, on the one hand, to the strict criteria for evaluation of the applied methodology, and on the other hand to the poor general condition of the forests in the area, which in turn is determined mainly by anthropogenic causes. Habitats 9180*, 91S0* and 91Z0 are in better conservation status, but not the optimal one. The information presented encompasses the essence of natural and anthropogenic degradation processes in these forests as the occurrence of succession processes, consequence of intensive cuttings, cleaning of river beds, presence of quarries, roads, construction, intensive hunting and tourism. Threats are identified and referred to recommendations for their control. The application of friendly forestry activities and more purposefully performed cultivation activities is recommended. For

Habitat types 91E0*, 91F0 and 9180* some stricter measures, such as the prohibition of logging and extraction of inert materials are listed.

Key words: assessment, degradation, measures, protected areas, threats.

STOMATAL CONTROL ON PHOTOSYNTHESIS IN DRYED SAPLINGS OF GENUS *PINUS*

Adriana Ivanova*, Svetoslav Anev, and Nikolina Tzvetkova

Department of Dendrology, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mails: adriana_1111@abv.bg*; svetoslav.anev@gmail.com; nikolina_tzvetkova@mail.bg

The stomata have a key role in the balance among the elements of gas-exchange. Under conditions of water deficit stomatal closing limits transpiration, but also suppresses photosynthesis, due to limited CO_2-uptake. During two years we have examined the level of stomatal control on the photosynthesis of Mountain pine (*Pinus mugo* Turra), Bosnian pine (*Pinus heldreichii* H. Christ.) and Macedonian pine (*Pinus peuce* Grisb.) saplings. The experimental plants were exposed to three different irrigation regimes according to the information about the annual course of precipitations: typical for the natural area of the species, for years with extremely dry periods during July and during August. A species specific stomatal control on the rate of photosynthesis at different irrigation regimes was established. In Bosnian pine saplings stomatal control was highest and almost independent on the irrigation regime. In Mountain pine saplings stomatal control increased remarkably under drought and also did not show any significant dependence on the period of drought. On the opposite, in Macedonian pine saplings stomatal control on photosynthesis decreased significantly during the drought periods and was strongly dependent on the irrigation regime. Different reaction of photosynthesis to stomatal conductance could be used as a good indicator for the adaptability of the examined species to summer drought.

Key words: drought, gas-exchange, physiological response, stomatal conductance.

XYLOGENESIS OF *PINUS HELDREICHII* H.CHRIST AND *PINUS PEUCE* GRISEB. IN NP "PIRIN"

Albena Ivanova*, Anita Kostadinova, Momchil Panayotov, and Stefan Yurukov

Department of Dendrology, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mails: albenabeti@gmail.com*; anita_kostadinova@abv.bg; mp2@abv.bg; syurukov@abv.bg

Pinus heldreichii H.Christ and *Pinus peuce* Griseb. are tree species characterized by longevity. Previous studies have outlined the potential for constructing long tree ring chronologies which may be used for studying the climatic variation in the past. Our aim was to study the cambial activity, production of tracheids and their differentiation during the growth period. We chose 100–250 years old *Pinus heldreichii* and *Pinus peuce* trees from natural forests in Pirin Mts. From 2010 to 2013 we took microcores every 10 to 14 days, prepared samples with sliding microtom GSL-1, recorded them with digital camera and then analyzed the images to obtain information for the onset of cambial activity, the period of production of first cells, period until cells were produced, the moment of highest division rate and the differentiation of the cells. We found that in 2010 and 2011 the onset of cambial activity was delayed until the end of June – beginning of July. In 2012 it started at the beginning of June and in 2013 the first cell were produced in the middle of May. The late start in 2010 and 2011 was probably due to cold periods in April and May. Despite it the number of produced cells and related tree ring width was high. This confirms our initial hypothesis that warmer winters promote wider tree rings. The production of new cells continued until the end of September, while the differentiation until the middle of October. In both years *Pinus heldreichii* trees produced more cells than *Pinus peuce* trees. Our results outline the importance of understanding the xylogenesis processes and open new possibilities for construction of supra-long anatomical chronologies, which may provide new insight into the reflection of climate variability in tree ring anatomy.

Key words: anatomical chronologies, cambial activity, climate variability.

VOLUME TABLES FOR THE EUROPEAN BEECH (*FAGUS SYLVATICA* L.) OF KATO VERMIO OF IMATHIA REGION, NORTHERN GREECE

Alexandros-Michail Chatziminiadis, Kyriaki Kitikidou*, and Elias Milios

Department of Forestry and Management of the Environment and Natural Resources, Democritus University, 193 Pantazidou str., 68200 Orestiada, Greece.
*E-mail: kkitikid@fmenr.duth.gr

For the European beech forest of Kato Vermio of Imathia region (Northern Greece), regression models, which estimate the volume using breast height diameter and total height as predictor variables, were fitted. The study area was randomly sampled, with a final sample of 120 trees. Five regression models were tested: the logarithmic model, the constant form factor model, the combined variable model, the generalized combined variable model and the generalized logarithmic model. Data was splitted for fitting (80 %) and validation (20 %). Selection of the best model was based on 3 comparison criteria (bias, standard error of the estimate and R^2), calculated for both fitting and validation data. The selected model for volume estimation is $v_{est} = 0.047D^2H$ with $R^2 = 0.75$ and standard error of the estimate is 0.08.

Key words: regression models, tree volume estimation.

USE OF LOG DAMS FOR EROSION CONTROL – ASSESSMENT CONSIDERATIONS

Fotios Maris and Kyriaki Kitikidou*

Department of Forestry and Management of the Environment and Natural Resources, Democritus University, 193 Pantazidou str., 68200 Orestiada, Greece.
*E-mail: kkitikid@fmenr.duth.gr

Log erosion dams are used in logging areas with moderate and high fire risk, where hill slope erosion rates are increased significantly by the fire. Log dams are logs placed in a shallow trench on the contour and trap sediments if laid in a bricklayer pattern on the hillslope. The potential volume of sediments stored is dependent on the slope, size, and length of the felled trees, and on the proper implementation. The purpose of log dams is to reduce erosion by shortening slope length, providing surface roughness, improving infiltration, and trapping sediments. Suitable sites are hill slopes with high and moderate burn severity, slopes between 25 and 60 %, areas where water repellent soils are present, soils with high erosion hazard ratings and watersheds with high values at risk. Studies in experimental applications in Greece, and material provided by the United

States Department of Agriculture (USDA) Forest Service, showed low effectiveness of log dams. Cost is considered high (up to 2500 € per hectare), including treatment of the terrain, site access, number of logs placed per hectare, and crew knowledge and experience, while quantitative studies on the sediment trapping gave up to 136 m^3 per hectare. Observations indicated that the logs are more effective at trapping sediment if the 10-minute rainfall intensity is low (less than 30 mm per hour). Soil end berms can increase the sediment storage up to 15 %.

Key words: sediment barriers, soil protection.

FOLIAR NITROGEN CONTENT AND NITROGEN RESORPTION EFFICIENCY ACROSS A GRADIENT OF EUROPEAN FORESTS AS AFFECTED BY TREE DIVERSITY AND ENVIRONMENTAL DRIVERS

Mariangela N. Fotelli[1], Kyriaki Kitikidou[2], and Kalliopi Radoglou[2*]

[1]Hellenic Agricultural Organization Demeter, Forest Research Institute, Vassilika, 57006 Thessaloniki, Greece.
[2]Department of Forestry and Management of Environment and Natural Resources, Democritus University of Thrace, Pantazidou 193, 68200, N Orestiada, Greece.
[*]E-mail: kradoglou@gmail.com

Given that soil N availability is a limiting factor in terrestrial ecosystems, any changes of N concentration in plant tissues many affect major ecological processes, such as litter decomposition, soil chemistry, herbivory etc. This is reflected in foliar N content and the Nitrogen Resorption Efficiency (NRE) by senescent leaves, which is the proportional withdrawal of N by the leaves prior leaf fall. NRE, furthermore, determines the degree to which a plant has to depend on soil N uptake, rather than its own N pools. The fact that more than 60 % of foliar N is desorbed by the leaves during senescence reveals the ecological importance of NRE. Within our study, foliar N and NRE have been determined in more than 300 plots, characterized by different tree diversity levels, established in 6 representative forest types across Europe. Furthermore, it has been examined how species mixture and various environmental parameters control the patterns of these parameters. Overall, it was found that foliar N increases and NRE decreases with increasing tree diversity level. However, the underlying mechanisms explaining these patterns differ among the different forest types.

Key words: biodiversity, leaf fall, nitrogen pools.

ASSESSING THE EFFECT OF FUEL TREATMENTS ON FIRE BEHAVIOR IN BLACK PINE (*PINUS NIGRA* ARN.) PLANTATIONS IN SOUTHERN BULGARIA

Konstantinos Koukoulomatis[1*] and Ioannis Mitsopoulos[2]

[1]University of Forestry, 10 St. Kliment Ohridski blvd., Sofia, Bulgaria.
[*]E-mails: kostaskard@hotmail.com, bombardier415@yahoo.gr
[2]The Global Fire Monitoring Center, Fire Ecology Research Group, c/o Freiburg University, Georges-Köhler-Allee 75, 79110 Freiburg, Germany

Fuel treatments have become the preferred strategy of many fire managers and forest agencies for reducing fire hazard in conifer forests. This study attempts to characterize the effectiveness of nine fuel treatments through simulation of potential fire behavior in Black pine plantations in southern Bulgaria. Fuel complex characteristics that influence fire behavior were measured in ten Black pine plantations, using standard surface and canopy fuel inventory methods. Nine different fuel treatments (control, prescribed burning, controlled grazing, thinning without slash removal, thinning with slash removal, thinning and prescribed burning with slash removal, thinning and controlled grazing with slash removal, thinning and prescribed burning without slash removal, thinning and controlled grazing without slash removal) were simulated by adjusting surface fuels (total load, load-by-size class, depth) and canopy fuels (available canopy fuel load, canopy base height, canopy bulk density) under dry weather and fuel moisture conditions. Differences in fire behavior parameters among the proposed fuel treatments were assessed by performing the Kruskal-Wallis nonparametric multiple comparison test. The simulations showed a statistically significant impact of prescribed fire and/or controlled grazing followed by thinning, indicating that this type of fuel treatment can be used to reduce wildfire hazard in Black pine plantations. Management of Black pine plantations should include an analysis of how the proposed actions (logging, thinning, etc.) may affect fuel complex properties and potential fire behavior. Fuel treatment plans should be an essential component of forest management in Black pine in Bulgaria, in order to reduce fire hazard.

Key words: conifer plantations, fire management, fuel complex, silvicultural treatments, wildfire hazard.

PUBLIC AWARENESS AND SATISFACTION TOWARD RECREATIONAL TRAILS IN URBAN FOREST, TAIWAN

Shyue-Cherng Liaw* **and Jia-En Sheu**

Department of Geography, National Taiwan Normal University, 10610 Taipei, Taiwan.
*E-mail: liaw@ntnu.edu.tw

The purpose of this research aims to study tourists' awareness and satisfaction toward three nearby forested trails in the Pakua Tableland in Chang-Hua County. We also study community residents' opinion about environmental impact in forested trails and to understand their behavior intention for environmental conservation practices. Based on the questionnaire and statistical analysis, results show that respondents, including tourists (n=397) and residents (n=394), often visit these nearby forested trails and stay there for a long time. The main motivations for respondents to visit forested trails include nature sightseeing, exercise and hiking, and relaxation and taking a rest. Through the factor analysis, tourists' awareness toward forested trails could be summarized into four factors including trail function, public participation, management, and eco-tourism. Tourists' satisfaction toward forested trails could be also classified into three factors including trail characteristics, trail resources, and trail facilities. In addition, community residents' opinions about environmental impact in forested trails could also be summarized into three factors including environmental ecology, social culture, and economic development. Community residents' behavior intention for environmental conservation practices are related closely to two factors, subjective norm and attitude. Overall, respondents generally appreciate the multi-functions of forested trails, and recognize the importance of public participation in trail management. They also highly satisfy trail characteristics and local resources.

Key words: community forestry, forest trail, recreational satisfaction, public participation.

DROUGHT RECONSTRUCTION DURING THE 5 LAST CENTURIES FOR AURÈS (NORTH-EASTERN ALGERIA) FROM TREE RINGS

Hamana Malki* **and Dalila Kherchouche**

Agronomic and Veterinary Institute, University Hadj-Lakhdar Batna, Boulevard KL, campus Hadj Lakhdar, 05000 Batna, Algeria. *E-mail: malkiham@hotmail.com

Drought is one of the main natural factors in declining tree-ring growth and dieback of cedar forests in the Aures Mountains (Algeria). In order to reconstruct the temporal variability of precipitation during the 5 last centuries, a regional chronology covering

a period of 556 years (1455–2010) was developed from *Cedrus atlantica* (Endl.) Manetti ex Carr. tree-rings. The response-function analysis between tree-ring index and instrumental data of precipitation for the data-availability period of 1971–2010, showed that the tree-ring index is highly correlated to the precipitation of October to June. The linear model estimating the precipitation from the tree-ring index was calculated for the period 1971–2010, then was applied on the regional chronology to estimate the precipitation from 1455. A drought threshold of 90 % of the mean of the instrumental data for the 1971–2010 calibration period was used to identify the dry years. The longest reconstructed drought period in the 556-year reconstruction is 4 years, which occurred in the 15th century (1559–1562). In terms of drought frequency, the reconstruction contains 99 dry events with a mean interval between events of 5.6 years. The 50-year moving frequency of dry years shows that the second half of the 16th century seems to contain the highest frequency of dry events (14 years). However in terms of drought severity, considered as the difference between the reconstructed precipitation and the drought threshold, the last half of the 20th century seems to be the worst for the reconstruction period. The drought severity reaching its maximum in 2002 can be linked to the massive dieback observed in cedar forests of Aurès in 2002.

Key words: *Cedrus atlantica,* Aurès (Algeria), dieback, moving average, precipitation, response function.

EPIPHYTOTIC OF POWDERY MILDEW IN SOUTH-EASTERN SERBIA

Miroslava Markovic*, Mara Tabakovic-Tosic, Snezana Rajkovic, and Ljubinko Rakonjac

Institute for Forestry, 3 Kneza Viseslava str., 11030 Belgrade, Serbia.
*E-mail: mira013@gmail.com

During the last decade main biotic agents causing severe damages to oak forests in Serbia were early and middle early defoliating insects of *Lepidoptera* order, and pathogenic fungus *Microsphaera alphitoides* Griff. et Maubl. This is very common but severe disease of oak in North Hemisphere that didn't occur on epidemic scale in Central and Southern-Eastern Europe until 1908 (Liovic and Zupanic 2006). Young leaves are the most sensitive to this pathogen, especially after defoliation by gypsy moth and early oak defoliators as was the case in the period 2011–2013 (primarily in south-eastern Serbia), which was followed by powdery mildew epiphytotic as the inevitable consequence. In the year 2014, south-eastern Serbia experienced not only high air temperatures caused by climatic changes but also extreme humidity in the period of mass infections, and the

combination of these factors greatly favoured the development of pathogens – powdery mildew agents. Throughout Serbia, powdery mildew was registered largely on *Quercus* species (*Quercus robur* L., *Quercus pubescens* Willd., *Quercus petraea* (Matt.) Liebl., *Quercus farnetto* Ten. and *Quercus cerris* L.), then on *Fagus* sp., *Castanea sativa* Mill., *Acer* sp., *Fraxinus* sp., *Ulmus* sp., *Betula* sp., *Corylus avellana* L., *Juglans nigra* L. and *Platanus* sp. (ranging from mild through medium up to strong attack). However, the intensity of the infection was the greatest in south-eastern and partially central Serbia, with over two-thirds of leaf mass under attack. The last outbreak of powdery mildew at epiphytotic scale that occurred in Serbia in 2005–2006 affected over 70 % of English oak trees, but it was also registered to a large degree on other species of trees. In the period of research, the mass occurrence of this fungus happened in the second half of July. It was also found on secondary foliage developed in early August, following defoliation by gypsy month. If next year's weather conditions favour the development of this pathogen, it would be realistic to expect spread of the infection over larger areas.

Key words: dieback, disease, forest, infection, oak, pathogen.

BIODIVERSITY CONSERVATION TACTICS AND SUSTAINABLE MANAGEMENT OF GREEK FORESTS: A REVIEW

Konstantinos Martinos[1]*, Elpiniki Skoufogianni[1], Alexandra Solomou[2], and Chrisi Stathaki[3]

[1]Laboratory of Agronomy and Applied Crop Physiology, Department of Agriculture, Crop Production and Rural Environment, University of Thessaly, Fytokoy str., 38446, N. Ionia, Magnisia, Volos, Greece. E-mails: kmartinos@uth.gr*; eskoufog@uth.gr
[2]National Agricultural Research Foundation, Institute of Mediterranean Forest Ecosystems Terma Alkmanos, Ilisia, 11528, Athens, Greece,e-mail: alexansolomou@gmail.com
[3]Laboratory of Infrastructure, Technology Policy and Development, Department of Planning and Regional Development, University of Thessaly, Pedion Areos, Volos, Greece. E-mail: hrstatha@uth.gr

The geographical position of Greece, its geomorphology, the presence of flora of past geological eras and the coexistence and interplay of biotic and non biotic factors have defined Greece as a country of high plant diversity and endemism, especially regarding forest ecosystems. The degree of underestimation of sustainable management is particularly high in southern and eastern Mediterranean countries. The current state of the country's forests includes many degraded ecosystems while the efficiency of the current management regime retains an ambiguous character. Considering the stress of climate change, the growing economic crisis and the vague character of Greece's legal framework, efficient and innovative forest management strategies are needed to

consider future forest dynamics in view of biodiversity conservation, in one of Europe's biodiversity hotspots. On the event horizon of the changing political scenery in Greece at the dawn of 2015, possibly new outtakes and perspectives on sustainable forest management remain to be seen. This paper aims at documenting past management strategies, demonstrating their faults and proposing new tactics for managing forests to achieve biodiversity conservation in Greece.

Key words: climate change, conservation strategy, forestry, Greece, SFM, species diversity.

IDENTIFICATION AND PATHOGENICITY OF THE MOST IMPORTANT TRACHEOMYCOTIC FUNGI ON *QUERCUS PETRAEA* (MATT.) LIEBL. IN SERBIA

Vesna Golubović Ćurguz[1], Dragan Karadžić[1], Ivan Milenković[2*], Katarzyna Sikora[3], and Zlatan Radulović[2]

[1]Faculty of Forestry, University of Belgrade, 1 Kneza Višeslava str., 11030 Belgrade, Serbia.
E-mails: dragan.karadzic@sfb.bg.ac.rs; vesna.curguz@sfb.bg.ac.rs
[2]Institute of Forestry, 3 Kneza Višeslava str., 11030 Belgrade, Serbia.
E-mails: zlatan.radulovic@forestorg.rs; ivan.milenkovic@sfb.bg.ac.rs*
[3]Forest Research Institute – IBL, 3 Braci Lesnej str., 05090 Raszyn, Poland.
E-mail: k.sikora@ibles.waw.pl

Mass decline of oak trees is a widespread phenomenon in many European countries, as well as in Serbia, and this phenomenon is driven by different causes. The most intensive oak decline in Serbia was registered in Eastern Serbia, and sessile oak (*Quercus petraea* (Matt.) Liebl.) was the most affected host. In the area of Majdanpečka domena in Eastern Serbia, differenet fungi were isolated from necrotic oak tissue and detailed morphological identification was performed. The presence of different parasitic and saprophytic fungi was confirmed, and among them the most important species were those causing traheomycotic wilt. After the detailed molecular identification (PCR and sequencing of the ITS region), presence of *Ophiostoma quercus* as the main cause of oak decline was confirmed. Some physiological features of this fungus were tested in laboratory conditions, including the influence of different types of nutrient media on the mycelial growth. Also, the effect of different temperatures on the growth rate of mycelium was tested, with the determination of the temperature optimum. Additionally, enzyme activity of fungus was determined, primarily production of oxidase and reductase. In order to fulfill Koch's postulates, pathogenicity test was performed on young oak trees. Three-weeks-old, pure cultures of fungus were incubated on MEA media at 20 °C. Every tree was inoculated on two places (stem base and 1.3 m) with fragment of agar and mycelium, using the 1-cm-diam. cork-borer. Control group of trees

were only mechanically injured with cork-borer at the same positions as inoculated trees. Experiment was controlled every three months and inoculated and control trees were inspected for the presence of any changes. One year after inoculation, first symptoms of decline were recorded on individual trees, and tissue samples were collected for further laboratory analyses.

Key words: diseases, oak decline, *Ophiostoma quercus*, molecular identification, nutrient media, temperature optimum.

THE MOST COMMON FUNGI AND PSEUDOFUNGI ON SWEET CHESTNUT (*CASTANEA SATIVA* MILL.) IN CENTRAL SERBIA

Zlatan Radulović[1], Dragan Karadžić[2], Vesna Golubović Ćurguz[2], and Ivan Milenković[1*]

[1]Institute of Forestry, 3 Kneza Višeslava str., 11030 Belgrade, Serbia.
E-mails: zlatan.radulovic@forestorg.rs; ivan.milenkovic@sfb.bg.ac.rs*
[2]Faculty of Forestry, University of Belgrade, 1 Kneza Višeslava str., 11030 Belgrade, Serbia.
E-mails: dragan.karadzic@sfb.bg.ac.rs; vesna.curguz@sfb.bg.ac.rs

Sweet chestnut is rare species in Serbia, except of western part of Metohija. This species is the most affected by pathogenic fungus *Cryphonectria parasitica,* cause of bark cankers and necrosis, widely known as „chestnut blight". Also, other fungi and pseudofungi may appear on sweet chestnut, and they were the topic of these studies as well. Samples were collected on the next localities: Sobina and Muhovac near Vranje, Hisardžik near Prijepolje, Trnava near Čačak, nursery in Požega, and Predejane. During the three-year-studies, 38 species of fungi and five species of pseudofungi were registered on sweet chestnut in Serbia. Fourteen species of fungi from seven different families were registred on the leaves and fruits. The biggest damagies, particularlly on the leaves of young trees were caused by *Mycosphaerella maculiformis* and *Microsphaera alphitoides* Griffon & Maubl. On the fruits of sweet chestnut, the biggest economic damagies were caused by fungi from the genus *Fusarium* spp. and *Penicillium* spp., as well as by *Stromatinia pseudotuberosa* and *Botrytis cinerea*. On the trees and branches, total of 26 species from 17 different families were registered. From this number, 22 species from 14 different families belonged to the kingdom of Fungi, and three species from three different families belonged to the kingdom of Protozoa. The most important fungi from this group is *C. parasitica*, causing „chestnut blight" of sweet chestnut trees. From the group of decay and rot fungi, the highest damagies are caused by *Laetiporus sulphurous*, *Ganoderma applanatum*, *Fistulina hepatica* and *Lenzites quercina.* From the roots and the stem base of sweet chestnut trees, three species from two families were isolated. One species belonged to the kingdom Fungi and two species from one family

belonged to the kingdom Chromista. The biggest damages are caused by *Phytophthora cambivora* and *Armillaria mellea.*

Key words: chestnut blight, decay, diseases, *Phytophthora* rot root.

CLIMATIC CHANGES AND THREATENING FACTORS OF FOREST ECOSYSTEMS IN SERBIA

Milan Medarević[1], Dragan Karadžić[2], Ljubodrag Mihajlović[2], Ivan Milenković[3*], and Snežana Obradović[1]

[1]Department of Forest Management, Faculty of Forestry, University of Belgrade, 1 Kneza Višeslava str., 11030 Belgrade, Serbia. E-mails: milan.medarevic@sfb.bg.ac.rs; snezana.obradovic@sfb.bg.ac.rs

[2]Department of Forest Protection, Faculty of Forestry, University of Belgrade, 1 Kneza Višeslava str., 11030 Belgrade, Serbia. E-mails: dragan.karadzic@sfb.bg.ac.rs; ljubodrag.mihajlovic@sfb.bg.ac.rs

[3]Department of Forest Protection, Institute of Forestry, 3 Kneza Višeslava str., 11030 Belgrade, Serbia. *E-mail: ivan.milenkovic@sfb.bg.ac.rs

Trend of temperature growth is present on entire area of Serbia, except the S-E part, where slightly negative trend was recorded (Popović et al. 2008). Average air temperature in Serbia is increasing more than 2.5 C per 100 years (trend for 1971–2005). Precipitation is characterized by greater variability than temperature. The intensity of droughts has increased, and 2000 and 2012 were with extremely strong droughts. Similar trend was recorded in the precipitation values during the summer. After 1984, summers with droughts are prevailing, and the most intensive droughts were recorded during the years 2000 and 2003. Effects of climatic changes are more frequent, including forest fires, declining, windbreaks, snow-breaks, ice-breaks, ice-overthrows and insect outbreaks. A quantitative effect in the year 2013 is 260,000 ha of forests under the gypsy moth outbreak. According to Ministry of Agriculture, Forestry and Water Management, the biggest areas of forests affected with forest fires were during the 1996 (7,016 ha), 2000 (13,201 ha), 2007 (16,144 ha), and 2012 (11,462 ha). Between the 2012 and 2014, entire area of Serbia was affected with forest decline and all tree species were affected. During the winter in 2014/2015, the area of 42,300 ha was affected with snow-breaks, snow overthrows, ice-breaks and ice overthrows. During the 2014, flashfloods activated about 11,500 flashflood streams in Serbia. Basic conclusion is that forest decline, forest fires, and calamities (not excluding the other negative impacts), intensified by climatic changes, have far-reaching negative consequences. All three phenomena are: more frequent and more expressed, dynamic and spontaneous; they have catastrophic character due to their extent and negative impact; they are followed

by chaining of damages; and they are questionless factors of risks, which relativize the possibilities of sustainable management in relation to multifunctional concept as its basis. Current effects of listed phenomena are: breaking of the stand density; reduction of bio-ecological stability; reduced productivity; unfavorable status of mixture; removal from the optimal taxation parameters; unfavorable structure of stands; threatening of biodiversity; threatened principles of sustainability, multi-functionality, and strategic objectives, related to development of current status of forests (from 30 % to 40 % of coverage); reduced possibility of real planning in more expressed risk conditions, caused by climatic changes.

Key words: droughts, fires, insect outbreaks, sustainable management, forest decline.

SELECTION OF THE MOST APPROPRIATE TREE SPECIES FOR DEVELOPING FOREST AREA USING MULTI-CRITERIA METHOD

Fardin Moradzadeh[1*], Sasan Babaie Kafaki[2], Nabi Azizi[1], and Fatemeh Mousavi[1]

[1]Department of Forestry, Faculty of Natural Resources, University of Tehran, Emamzade Hassan Avenue, Karaj, Postal Code: 4111, Iran. [*]E-mail: f_moradzadh@ut.ac.ir
[2]Department of Forestry, Faculty of Natural Resource, Islamic Azad University, End of Satari highway, Islamic Azad University Square, Tehran, Postal Code: 14515/775, Iran.

Selection of tree species plays a major role in the success or failure of a forestation project. So, in this regard, different influencing factors need to be examined carefully. To do this, regarding to determining the purpose based on forest area development, first initial assessments were conducted in the study area and environmental and ecological factors affecting compatibility of the species were determined by expert opinion, finally, were studied in the multi-criteria evaluation process. It should be noted that Multi Criteria Evaluation, the final weight of each indicator was determined using the SAW method and Interaction of all related indicators was obtained as a record of information as the final value. Based on this information, the ability of lands for developing forest was classified into four capability classes. Finally, considering to surveys conducted, capability classes of 1 and 2 were selected for planning the forest area development, and according to capability class in each region and its compatibility with the ecological requirements of tree species, the most appropriate species were selected and development capability map was prepared for each species.

Key words: area development, ecological factors, forestation, SAW method.

EFFECT OF ROAD PACKER PLUS ON FOREST ROAD SOIL STABILIZATION

Fatemeh Mousavi*, Ehsan Abdie, and Baris Majnounian

Department of Forestry, Faculty of Natural Resources, University of Tehran, Emamzade Hassan Avenue, Karaj, Postal Code: 4111, Iran. E-mails: fmusavi@ut.ac.ir*; abdie@ut.arc.ir; bmajnoni@ut.ac.ir

Most of the damages to forest roads are directly related to properties of bed road soil. Some soil cause many problems to road because of their undesirable mechanical properties. Several methods have been proposed for improving mechanical properties of soil and in this study, the effect of Road Packer Plus (RPP) to improve physical and mechanical properties of soil is assessed. Various laboratory tests, including identify, Atterberg limit, compaction and California Bearing Ratio (CBR), were performed on control and treated samples with recommended percentage of producer. The results of these tests indicated that adding this material to soil decreased liquid limit, plasticity limit and plasticity index. It also increased maximum dry density and bearing capacity of soil. But the amount of improvement was less than producer claim and was not significant from technical point of view.

Key words: Atterberg limit, bearing capacity, compaction, California Bearing Ratio (CBR).

EVALUATION OF QUANTITATIVE AND QUALITATIVE CHARACTERISTICS OF ZAGROS FOREST

Koroush Nazarpour* and Vahid Etemad

Department of Forestry, Faculty of Natural Resources, University of Tehran, Emamzade Hassan Avenue, Karaj, Postal Code: 4111, Iran. *E-mail: knazarpoor@ut.ac.ir

Due to climate change and increasing deterioration in Zagros forests, access to accurate and update information of these forests is the prerequisite of decision-making and planning about them. We aimed at performing qualitative and quantitative analysis of the forests located in Kuhdasht County. We set 90 rectangular sample plots with area of 1000 m^2 (20×50 m) using random systematic method. In order to assess the qualitative and quantitative characteristics, large and small diameters of tree crown, tree height, number of sprout, the frequency of regeneration and seedling height in the plots were measured. The results showed that there were in average 207.5 trees per ha, canopy cover of 16.7 %, 3.35 sprouts, and mean height of 4.48 m. The highest number of trees occurred in diameter class of 10 cm. Oak species were most frequent, with 95 %. Health

and vitality of trees were: 32 % with healthy vitality, 48.55 % with average to good vitality, 11.45 % with moderate vitality and 8 % with poor vitality. Most of regeneration in the area belonged to Persian oak (*Quercus brantii* Lindl. var. *persica*) with coppice origin and in the height classes less than 0.5 m.

Key words: canopy cover, Persian oak, *Quercus brantii* Lindl. var. *persica,* random systematic, sprout.

NEW HYPOGENEOUS FUNGI FOR BULGARIA

Teodor Nedelin[1*], Slavcho Savev[1], Kaloyan Kostov[2], and Melania Gyosheva[3]

[1]Department of Silviculture, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mails: teodor_nedelin@hotmail.com[*]; ssavev@abv.bg
[2]Agrobioinstitute, 8 Dragan Tzankov blvd, 1164 Sofia, Bulgaria. E-mail: kkostov@abi.bg
[3]Department of Plant and Fungal Diversity and Resources, Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., bl. 23, 1113 Sofia, Bulgaria. E-mail: melanygyosheva@abv.bg

Truffles are not only one of most high-prized hypogeous fungi, but also have a significant contribution for establishment of successful plant community. Because of their cryptic lifestyle, they are often overlooked and neglected in different studies. As a pioneer species they are reported as one of the main component of ectomycorrhizal diversity in various ecosystems. *Tuber* spp. generally grows in calcareous soils, but some of them are adapted to slightly acidic soils. Most of them has a relatively wide host range and growing conditions and very few are restricted to particular ones. The very low level of knowledge about this fascinating group in Bulgaria is due to lack of any tradition for truffle collecting. Two true truffle species – *Tuber fulgens* Quél. and *T. rufum* Picco were found for first time in Bulgaria. For this study we have combined standard mycological methods of staining fungal tissues and examination – via Light, Phase-Contrast and Scanning electron microscope and molecular techniques, which are used for more than two decades for rDNA fungal sequencing of ITS1 and ITS2 regions. For this purpose we have adapted DNA extraction protocol for plants from Delaporta. The results shows, that macroscopic and sometimes microscopic features alone not always provide sufficient data for identification. This is especially true when truffle are old or immature and belongs to the group of white truffles. The present study and geographic position of Bulgaria, firmly confirms a hypothesis that most of Central European hypogeneous fungi could be found.

Key words: ascomycetes, Bulgarian mycota, ectomycorrhizal, fungal conservation, truffle.

TECTONA GRANDIS – PAST, PRESENT AND FUTURE

Galina A. Novitskaya[1], A. A. Novitskaya[1*], and S. A. Potapova[2]

[1]Russian Social State University, Moscow, 129226, Russia.
[*]E-mail: galina-novitskaya@mail.ru
[2]Main Botanical Garden Russian Academy of Sciences, Moscow, 127276, Russia.
E-mail: 5254957@bk.ru

The teak (*Tectona grandis* L., Lamiaceae), deciduous tree is found throughout much of Southeast Asia. Here it attains the largest dimensions, up to 56.5 m in height (recorded in Malabar), the maximum girth 8 m in Myanmar. Teak is native to India, Myanmar, Thailand and Indonesia. It is reported to have attained an age over 500 years. A tree cut down in forest of Mysore showed 680 annual rings. It grows best in fertile, well-drained soil and warm, tropical climates where it receives plenty of sunshine. The species depends on pollination by insects (mainly bees) for survival. We are observed teak at parks many towns of North India and visualized at forest cultures from way Delhi – Haldwani and our dendrology interest was began. Although the tree itself can still be found widely, native teak forests in places such as India and Thailand have largely disappeared because of unsustainable logging. Teak's natural resistance to decay and termites, shipworm makes it an ideal material for building projects in coastal environments, especially bridges, docks and boats. Teak is also used in traditional Southeast Asian medicine for its astringent and diuretic properties, which assist in reducing swelling. It's also used traditionally to treat diabetes, and laboratory tests have demonstrated that its bark extract effectively lowers insulin resistance in mice. India has over 9.77 million ha under natural teak forest. The demand for teak has far exceeded its natural supply, and plantations have been set up to grow teak throughout much of the tropics. Nilambur in Kerala is famous for its teak forests planted in 1842. Chatu Mehon, well known as the father of Indian teak plantations, raised more a million teak plants 1842–1862. Organized plantations on large scale were attempted only after 1948, and until 1951 plantation was not a regular and extensive activity. In first, planting was undertaken mainly in government-owned forests, and little importance was given to plantations on private land. India has more than 500,000 ha of teak plantations, and there is a large ongoing programmed to plant almost 50,000 ha annually.

Key words: forest, parks, plantations, teak tree.

LARGE-SCALE NATURAL DISTURBANCES IN BULGARIA – A HISTORICAL OVERVIEW

Momchil Panayotov[1*], Evgeni Tsavkov[1], Georgi Gogushev[2], and Peter Bebi[3]

[1]Department of Dendrology, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mails: mp2@abv.bg[*]; tsavkov@abv.bg
[2]Regional Forest Directorate, Blagoevgrad, Bulgaria. E-mail: gogushev_g@abv.bg
[3]WSL Institute for Snow and Avalanche Research SLF, Switzerland. E-mail: bebi@slf.ch

Large-scale natural disturbances are among the most important factors shaping forest landscapes. In the recent decades in European coniferous forests there has been increase in windthrows and bark-beetle outbreaks. These events, together with fires, which traditionally are the major disturbance factor for Southern European forests, pose numerous questions and challenges for the management of forest ecosystems. In this context it is of crucial importance to better understand forest disturbance regimes. We collected and analyzed data for natural disturbances in mountain coniferous forests in Bulgaria from a variety of written sources. We found data for more than 100 natural disturbances in the period 1849–2010, in natural and artificial forests. The two most important types in coniferous forests were windthrows and fires, which together accounted for more than 85 % of all records. Less frequent were notes for damages caused by ice or snow accumulation on trees. The biggest recorded disturbances were the "Batalach" fires (1891 and 1905) with territory of over 4000 ha and the "Beglika" windthrow (1961, 3000 ha), both of which happened in the Rhodopa Mountains. In the second half of the 20th century large-scale fires were less frequent, probably as a result of fire-suppression policies. Yet, a recent 70 ha fire in "Bistrishko branishte" reserve demonstrated that such events should still be expected. In recent decades windthrows were the most numerous events. Our analysis points out that natural disturbances such as fires and windthrows are important for Bulgarian mountain coniferous forests and may become even more important with expected warmer temperatures and drought in future.

Key words: fires, bark beetle outbreaks, windthrows, mountain forests.

NEW DATA ABOUT ALIEN INSECT PESTS ON ORNAMENTAL PLANTS IN BULGARIA

Aneliya Pencheva[1] and Mariya Yovkova[2*]

[1]Department of Plant Pathology and Chemistry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mail: ajp84@abv.bg
[2]Institute of Ornamental Plants, Negovan, 1222 Sofia, Bulgaria.
[*]E-mail: mariya_yovkova@abv.bg

In this study the results of recent surveys (during the period between 2012 and 2014) on alien insects, infesting ornamental plants in Bulgaria are reported. Ten species associated with urban landscape areas are discussed. Two of them are reported for the first time in Bulgaria – *Ceroplastes sinensis* Del Guercio and *Lepidosaphes flava* (Signoret). Furthermore, *Acizzia jamatonica* (Kuwayama) and *Cydalima perspectalis* (Walker) have been found in new localities. *Metcalfa pruinosa* (Say) and *Pseudaulacaspis pentagona* (Targioni Tozzetti) have widened their host range in our country. Additional distribution data are also provided for *Aulacaspis yasumatsui* Takagi and *Cacoecimorpha pronubana* (Hübner) in Bulgaria. *Opogona sacchari* (Bojer) has not been found in its previous localities. Details on current distribution and host plants are reported for each species and biological remarks are given for *Cydalima perspectalis* (Walker) and *Ceroplastes sinensis*.

Key words: distribution, invasive species, jumping plant lice, moth, plant hopper, scale insect.

GROWTH AND STATE OF DOUGLAS-FIR (*PSEUDOTSUGA MENZIESII* (MIRB.) FRANCO) IN THE REGION OF YUNDOLA TRAINING AND EXPERIMENTAL FOREST RANGE

Krasimira Petkova[1*], Yavor Poryazov[2], and Raisa Petrova[3]

[1]Department of Silviculture, Faculty of Foresrtry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. [*]E-mail: kpet@abv.bg
[2]Department of Forest management, Faculty of Foresrtry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mail: yavoracer@abv.bg
[3]State Forest Service – Office Platchkovtsi, 17 Balkan str., 5360 Platchkovtsi, Bulgaria, E-mail: raisa_koeva@abv.bg

The aim of the study was to research the growth and the state of Douglas-fir plantations in the region of the Training Experimental Forest Enterprise Yundola. It was studied four Douglas-fir plantations which are from 40 to 55 years old, located between 1400

to 1600 m above sea level. In each of plantations were determined mean height and diameter at breast height, site index, stem volume and mechanical resistance of Douglas-fir. The results show that the Douglas-fir had the best growth on the medium rich and fresh habitat with sunny exposure and altitude of 1600 m as of age 55 reached a mean height of 32.4 m. The average diameter at breast height of the researched plantations reach to 30 cm and more, that show they are suitable for large size wood harvesting. The average stem volume of Douglas-fir in the most of the studied plantations to age 55 is in the range of 400–600 m^3/ha, with an average annual volume increment from 7 to 12 m^3/ha.year. The high index of mechanical resistance indicated risk of abiotic damages, which determines implementation of felling as soon as possible.

Key words: diameter at breast height, forest plantations, mean height, mechanical resistance, stem volume.

PHYSICAL PROPERTIES OF DEPOSOL AND WATERING NEEDS PEDUNCULATE OAK (*QUERCUS ROBUR* L.) TREE ROW SEEDLINGS

Sasa Pekec*, Sasa Orlovic, Andrej Pilipović, and Srđan Stojnić

Institute of Lowland Forestry and Environment, 13 Antona Cehova str., 21000 Novi Sad, Serbia. *E-mail: pekecs@uns.ac.rs

This paper presents investigation of soil in the urban area of Novi Sad, which extends along one of the main boulevards with tree rows consisting of planted seedlings of pedunculate oak (*Quercus robur* L.) where soil samples were taken at four locations. The first two sites (T1 and T2) were without irrigation system, while on the other two sites (T3 and T4) irrigation system near the plants was installed. According to granulometric composition, sites T1 and T2 had heavier texture with a share of total clay from 41.56 % to 61.80 %, and texture classes: loam, sandy clay loam and sandy loam. At sites T3 and T4 lighter mechanical composition of the soil was recorded with increased participation of the total sand ranging from 61.52 % to 67.64 %, while the textural classes were identical, ie: sandy loam. The specific mass of the tested soil ranged from 1.8 g/cm^3 to 2.2 g/cm^3 while the volumetric bulk density in the range of 1.35 g/cm^3 to 1.60 g/cm^3. The content of immediate moisture,varies on the sites T1 and T2 which are not irrigated, in comparison to the sites T3 and T4 with irrigation system. In non irrigated sites, average value of recorded moisture ranged from 52.06 mm to 62.60 mm, while at irrigated sites values were much higher, from 90.53 mm to 226.36 mm. The need for watering of non irrigated sites ranged from 437.41 mm to 447.94 mm of water while in the irrigated part the need had smaller amounts of 273.64 mm to 409.47 mm of water, which is properly distributed throughout the year. According to the established

properties of the investigated deposol land, and on the basis of the recommended rate of irrigation on this land, it can be concluded that implemented irrigation preserves and enhances vitality of trees planted in urban conditions.

Key words: irrigation, moisture, soil.

RESPIRATION OF FOREST SOILS IN DIFFERENT FOREST STANDS DURING DRY AND WET SEASONS

Andrej Pilipović[1*], Sasa Orlovic[1], Zoran Galić[1], Milan Borišev[2], Milan Drekić[1], Miroslav Markovic[1], and Leopold Poljakovic-Pajnik[1]

[1]Institute of lowland Forestry and Environment, University of Novi Sad, 13 Antona Cehova str., 21000 Novi Sad, Serbia. [*]E-mail: andrejpilipovic@yahoo.com
[2]Department of Biology and Ecology, Faculty of Sciences, University of Novi Sad, 13 Antona Cehova str., 21000 Novi Sad, Serbia.

Respiration of forest soils (Rs) presents release of carbon dioxide to the atmosphere through processes such are root respiration, organic matter microbial degradation and other chemical processes. It is one of the main components in ecosystem carbon cycle considering the fact that soils are largest terrestrial carbon pool and every disturbance of Rs affects overall carbon budget. The process itself is highly dependent upon climatic conditions, especially upon soil temperature and soil moisture, which affects different partitions of total Rs, autotrophic and heterotrophic respiration. This research presents investigation of the forest soil respiration of different forest stands in two climatically different years: with severe lack of precipitation (2013) and with intensive precipitation during vegetation period (2014), funded by Ministry of Education and Science of Republic of Serbia – Project No III43002. Research included Common beech stand at Mt Stara planina, Norway spruce stand at Mt Kopaonik and mixed Silver fir-sprice-beech stand at Mt Tara. Investigated parameters related to respiration processes were: soil respiration (Rs), evaporation (E), soil temperature (Tsoil), soil moisture content (SWC) and air temperature (Tair). Soil respiration values ranged from 4.684 $\mu mol \cdot CO_2 \cdot m^{-2} \cdot s^{-1}$ in June 2014 to 0.967 $\mu mol \cdot CO_2 \cdot m^{-2} \cdot s^{-1}$ in September 2013 at Mt Stara planina, from 2.70 $\mu mol \cdot CO_2 \cdot m^{-2} \cdot s^{-1}$ in July 2014 to 1.10 $\mu mol \cdot CO_2 \cdot m^{-2} \cdot s^{-1}$ in June 2013 at Mt Kopaonik, while the amplitude at Mt Tara was smaller and ranged from 3.30 $\mu mol \cdot CO_2 \cdot m^{-2} \cdot s^{-1}$ in September 2014 to 1.98 $\mu mol \cdot CO_2 \cdot m^{-2} \cdot s^{-1}$ in August 2013. Soil temperature values were affected by precipitations, but significant correlation with Rs was not recorded due to the lack of soil moisture in 2013. Results indicate complexity

of factors affecting soil respiration in investigated stands such are soil temperature and soil moisture.

Key words: Common beech, Norway spruce, Silver fir, soil respiration, soil temperature, SWC.

EFFECTS OF COLLECTION SEASON AND K-IBA APPLICATION ON ROOTING OF *OLEA EUROPAEA* VAR. *OLEASTER* STEM CUTTINGS

Ispikoudis Stefanos, Elias Pipinis*, and Pavlos Smiris

Laboratory of Silviculture, Department of Forestry and Natural Environment,
Aristotle University of Thessaloniki, P.O. Box 262, 54124 Thessaloniki, Greece.
*E-mail: epipinis@for.auth.gr

The present study investigates the rooting of Wild olive (*Olea europaea* var. *oleaster*) stem cuttings. Hardwood cuttings were collected from plants growing in their natural habitat in different seasons of the year (autumn, spring and summer) and were treated with 0 (control), 3000, 6000 and 12000 ppm K-IBA solutions. The cuttings, after the K-IBA application, were planted in a mixture of perlite and peat (3:1 v/v) and placed in an intermittent mist system for rooting. The collection season affected the rooting percentage of wild olive cuttings. In detail, the cuttings, which were collected in autumn, achieved the highest rooting percentage (40.6 %), whereas the lowest one was observed in the cuttings, which were collected in summer (7.2 %). The application of K-IBA solutions affected the rooting of wild olive cuttings. In autumn, the cuttings treated with the highest concentration of K-IBA (12,000 ppm) exhibited the lowest rooting percentage (17.8 %). Furthermore, the cuttings treated with 3000 ppm of K-IBA exhibited a significantly higher rooting percentage (60.0 %) than those which were not treated with K-IBA (37.8 %). In spring, the cuttings, which were not treated with K-IBA (control), showed the lowest rooting percentage (6.7 %), whereas no significant differences in rooting percentages in the cuttings treated with K-IBA solutions were observed (35.6–42.2 %). In summer, the rooting percentage of the cuttings treated with the lowest concentration (3000 ppm) of K-IBA (13.3 %) was higher than those of the cuttings treated with 12,000 ppm of K-IBA and the control ones (4.5 and 2.2 % respectively). Thus, for the vegetative propagation of wild olive species, collection of stem cuttings in autumn and treatment with 3000 ppm of K-IBA is proposed.

Key words: indole-3-butyric acid, vegetative propagation, Wild olive.

NUTRIENTS AND HEAVY METALS CONCENTRATIONS IN NEEDLES OF *PINUS BRUTIA* TEN. IN THESSALONIKI, GREECE

Maria Aslanidou[1*], Athanasios Papaioannou[2], Elias Pipinis[1], Olga Mavrokordopoulou[1], Matina Katsanidou[1], and Pavlos Smiris[1]

[1]Laboratory of Silviculture, Department of Forestry and Natural Environment, Aristotle University of Thessaloniki, P.O. Box 262, 54124 Thessaloniki, Greece.
[*]E-mail: maslan@for.auth.gr
[2]Laboratory of Forest Soil, Department of Forestry and Natural Environment, Aristotle University of Thessaloniki, P.O. Box 271,54124 Thessaloniki, Greece.

The present study is based on the differential concentrations of nutrients and heavy metals in *Pinus brutia* Ten. needles resulting from the influence of various factors, such as traffic and topographical conditions in four sites in the urban and periurban area of Thessaloniki, Greece. Two sites (parks) located near the busy traffic centre of the town and two sites located in the periurban forest (one site besides the ring-road and the other far away from the busy ring–road) were selected for the investigation. From each site, 20 needles samples were collected from 20 randomly selected *P. brutia* trees. The samples were properly prepared and nutrients concentrations of Na, K, Ca and Mg and heavy metal concentrations of Cu, Fe, Zn, Mn Pb, Cd, Ni and Cr were identified. The results showed that there were significant differences in nutrient and heavy metals concentrations of needles in the four sites. In particular, the samples of both sites located in the periurban forest exhibited significantly higher concentrations of Mg and Ca than the samples collected in sites near the centre of the town. The *s*ignificantly higher concentrations of K, which were observed in the samples collected from the two sites in the city, are possibly attributed to the fertilization of the parks. The higher concentrations of Na, which were found in the samples collected on sites of the periurban forest, are due to topographical conditions and aerial deposition. However, the highest level of Mn and Zn, which were observed in the samples collected in the site of the periurban forest located far away from the busy ring–road, are mainly attributed to soil type. Furthermore, in the samples collected in the site of the periurban forest far away from the busy ring–road the lowest concentration of Cu was found. High levels of Pb, Ni and Cr concentrations were found in the needles which were collected from the sites close to the busy traffic roads of Thessaloniki. No significant differences in the levels of Fe and Cd among the samples of the four sites were found.

Key words: periurban forest, pollution, ring-road traffic, trace elements, urban environment.

FOREST EXPERTS PERCEPTIONS ON FIRE MANAGEMENT IN FIR FORESTS OF GREECE UNDER A CHANGING CLIMATE

Ioannis Mitsopoulos[1], Yannis Raftoyannis[2*], and Dimitrios Bakaloudis[3]

[1]The Global Fire Monitoring Center, Fire Ecology Research Group, c/o Freiburg University, Georges-Köhler-Allee 75, 79110 Freiburg, Germany. E-mail: ioanmits@gmail.com
[2]Department of Forestry, Central Greece University of Applied Sciences, 36100 Karpenisi, Greece. [*]E-mail: rafto@teilam.gr
[3]Department of Forestry and Natural Environment, Aristotle University of Thessaloniki, 54124, Thessaloniki, Greece

The potential impacts that climate change may have on fire regime in ecosystems that are not fire-dependent have been recognized by the scientific community recently. Evidence for this emerges from fires that are nowadays spreading over higher altitudes and northern latitudes. This study conducted interviews in all forest units which manage fir forests in Greece and investigated the perceptions of forester managers on the issues of climate change and fire management in fir forests. The survey consisted of a broad set of questions covering all aspects of fire management such as fire prevention, fire suppression and post fire treatments. Forest management units have been divided into two distinct types based on their fire occurrence class (high fire occurrence units and low fire occurrence units) in order to detect if there are statistically different perceptions between experts with high experience in fire management and managers with less experience in fire issues. According to forest experts, fire prevention in fir forests under climate change should be focused on public awareness and fuel management. Nevertheless, the survey results indicate that there is also a need for specific fire prevention measures such as type of logging activities and other technical measures. The result of this survey highlighted the need for the establishment of a new firefighting organization and for the better coordination of all involved parties during fire suppression. An improved communication between science and management through the funding research is also rated as critical for supporting forest managers in their response to climate change, especially in post fire management of fir forests. Comparison of perceptions of the two fire occurrence classes showed a non-significant difference in adaptation options between the forest managers in most of the cases. The insights of forestry experts revealed in this study are expected to contribute to a judicial fire management in fir forests in the context of climate change. This research has been co-financed by the European Union (European Social Fund – ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) – Research Funding Program: ARCHIMEDES III, Investing in knowledge society through the European Social Fund.

Key words: adaptation to climate, fire prevention, fire suppression, post fire treatments, survey, wildfires.

INJURY OF OZONE – MONITORING PLOT – MOKRA GORA

Snezana Rajkovic[1*], Miroslava Markovic[1], Ljubinko Rakonjac[1], Radoslav Rajkovic[2], Aleksandar Lucic[1], and Milorad Veselinovic[1]

[1]Institute of Forestry, 3 Kneza Viseslava Str., Belgrade, 11030, Serbia.
[*]E-mail: srajkovic1@gmail.com
[2]University of Belgrade, Faculty of Mechanical Engineering, Innovation center, Queen Mary 16, Belgrade, 11000, Serbia. E-mail: radoslav.rajkovic@gmail.com

It can be diagnosed that many plant species react to ambient levels of ozone pollution with distinct visible foliar symptoms in the field. The assessment of ozone visible injury serves therefore as a means to estimate the potential risk for European ecosystems that are exposed to elevated ambient ozone concentrations. This problem has to be considered in the context of ICP Forests aiming among others to document the presence of environmental drivers that may affect forest condition across Europe. Harmonization of procedures is essential to ensure spatial and temporal data comparability. For the injury data being accepted for the international database and evaluations, National Focal Centers and their scientific partners that are participating in the UN/ECE ICP Forests program must follow the methods and apply the special manual. Methodologies, including quality assurance, such as data harmonization, completeness and plausibility tests have been applied according to the ICP Forests Manual, Parts VIII – Assessment of Ozone Injury. Specific targets are set as follows: quantification of injuries ozone on the selected parcel Level II in Europe; detection of temporal trends in the selected plot (significant changes within 10 years with a 95 % level of significance of individual plots). Our research estimates damage caused by ozone on beech leaves were carried out at the site Mokra Gora as a part of the project LEVEL II – Serbia. The assessment for visible ozone injury on main tree species is conducted on the leaves from the same branches where foliar analysis is carried out. It means from five trees use three branches. The samples for foliar injury are collected every second year from the upper sun exposed crown.

Key words: experimental plot, foliar injury, ozone.

MEDICINAL PLANTS IN PIRIN NATIONAL PARK

Anna Gavrilova[1], Boriana Sidjimova[2], Slavcho Savev[1*], and Elena Topuzova[3]

[1]University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria.
[*]E-mail: ssavev@abv.bg
[2]Institute of Biodiversity and Ecosystem Research – Bulgarian Academy of Sciences, 2 Gagarin str., 1113 Sofia, Bulgaria.
[3]Directorate of National Park Pirin, 4 Balgariya str., Bansko, Bulgaria.

The knowledge of the species diversity, distribution and abundance of medicinal plants in the protected areas has strong relation to the preservation of their genetical resources. This study was conducted to determine the current number of medicinal plant species, the condition of their resources and the areas suitable for gathering. The collected data will contribute to the regulation of medicinal plants gathering in the Management plan of Pirin National park and thus their protection. As a result of our study an updated systematic list of medicinal plants, distributed on the territory of Pirin National park was prepared. The systematic list includes 443 species of medicinal plants belonging to 69 genera of 82 families. The current conservation status at national and international level was indicated. On the basis of previous reference data and field research were established list of economically valuable medicinal plants on the territory of Pirin National park and the medicinal plants that can be collected only for personal usage. This information has been prepared for the needs of Pirin National park and was financed by OP Environment 2007–2013.

Key words: management plan, plant inventory, regimes.

STUDY ON FLORISTIC COMPOSITION AND NATURE CONSERVATION STATUS OF PLANT COMMUNITIES OF *ARCTOSTAPHYLOS UVA-URSI* IN PIRIN NATIONAL PARK

Slavcho Savev[1], Ina Aneva[2], and Petar Zhelev[1*]

[1]University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria.
E-mails: zhelev@ltu.bg[*]; ssavev@abv.bg.
[2]Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Acad. G. Bonchev Street, block 23, 1113 Sofia, Bulgaria. E-mail: ina.aneva@abv.bg

The paper presents results of a study on the natural habitats of Bearberry (*Arctostaphylos uva-ursi* (L.) Sprengel) in Pirin National Park. Floristic composition of the communities of the species was studied in experimental plots set in its main localities in Pirin National Park. Two types of communities were studied: forest communities situated under the

canopy of *Pinus nigra*, and subalpine communities, situated near the alpine tree line, in the meadows and among the *Pinus mugo* and *Juniperus sibirica* communities. The studies revealed high species diversity in the communities, with participation of many rare, endemic, endangered and protected plants. The habitats were evaluated as having high nature conservation value and favorable status, but necessity of proper management was also oulined. The results are discussed in the view of sustainable use of resources of this valuable and rare medicinal plant.

Key words: Bearberry, medicinal plants, mountain ecosystems, natural habitats.

ACTIVITY OF DIFFERENT ECTOMYCORRHIZAL TYPES OF CONIFEROUS STUDIED BY VITAL FLUORESCENCE

Tatyana Sizonenko

Department of Forest Biology Problems of the North, Institute of Biology of Komi, Scientific Centre of the Ural Branch of the Russian Academy of Sciences, 28 Kommunisticheskaya str., 167982 Syktyvkar, Russia. E-mail: tvor.83@mail.ru

Ectomycorrhizae play key role in functioning of forest ecosystems where they are also one of major carbon sink. Physiological activity of ectomycorrhizae was studied using assessment of vital cells fluorescence by fluorescein diacetate (FDA). Fluorescence activity of ectomycorrhizal mantles depends on physiological state of trees and species composition of fungi. Ectomycorrhizal root tips of Siberian spruce (*Picea obovata* Ledeb.) and Scots pine (*Pinus sylvestris* L.) were sampled in different boreal forest sites in European part of Russia (the Komi Republic) during one growing season and analyzed by fluorescence microscopy. After staining with FDA, tissue fluorescence was used to estimate activity of nine ectomycorrhizal types on *Pinus sylvestris* and seven types on *Picea obovata*. Certain differences occurred among ectomycorrhizal types in FDA-hydrolysing activity of the different tissue layers of mycorrhizae: cortex, hyphal mantel, Hartig net and stele. All main tissues of coniferous ectomycorrhizae with plectenchimatous mantels of type A were characterized by higher fluorescence activity. Fluorescence intensity of fungal mantels in ectomycorrhizae of types B, E, F, G and N was lower, but painting of stele indicated their activity as intermediate. Low activity of all tissues except for stele was registered in ectomycorrhizae of O-, Q- and RS-types, so, these types were classified as inactive ectomycorrhizae. Highest fluorescence of ectomycorrhizae was recorded in period of their maximum growth in seasonal dynamics. Insignificant quantity of ectomycorrhizae with low activity was found during all the observation season.

Key words: ectomycorrhiza, FDA fluorescence, Hartig net, hyphal mantel.

CONCEPTION FOR TYPOLOGY OF COMPOSITION IN LANDSCAPE ARCHITECTURE

Veselin Shahanov

Department of Park and Landscape Design, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mail: vshahanov@yahoo.com

Different kinds of compositions are used in landscape architecture practice, despite the fact that composition types are not deeply theorized or defined precisely as composition styles. The conception of styles concerned in landscape history and theory is a general issue. The current paper aims to explore the type as a concept which gives to a composition specific and aesthetic qualities. The research methodology includes the following three steps: several compositions have been analyzed and evaluated by different experts; a model for typology has been made, and as a result a conception for typology has been created. Exemplary compositions are explored through their drawings, plans or satellite images and are perceived as abstract, plane, graphic images. In this way their aesthetic qualities are explored isolated. The evaluation has been statistically checked. On the basis of comparative analysis of the best compositions, criteria for creation of a type model has been suggested. As a combination between the variables of the particular criteria certain types of compositions have been finally established.

Key words: design approach, geometrical pattern, type model, visual quality.

ENHANCED GROWTH CHARACTERISTICS OF *CASTANEA SATIVA* MILL. SEEDLINGS EXPOSED TO LED LIGHTS WITH CONTINUOUS SPECTRUM DURING INDOOR CULTIVATION

Sonia Smirnakou and Kalliopi Radoglou*

Department of Forestry and Management of Environment and Natural Resources, Democritus University of Thrace, Pandazidou 193, 68200 Orestiada, Greece.
E-mails: sosmirnakou@gmail.com, kradoglo@fmenr.duth.gr*, radoglou@fri.gr*

Previous studies demonstrated that combined effects of monochromic LEDs were an effective light source for plant growth of several species in artificial environments. However, there has not been discussion on the application of LED lights of continuous spectrum in plant growth chambers. This study examines the influence of five different LED light qualities (L20AP67, AP673L, G2, AP67 & NS1) that emitted a mixture of continuous spectrum based on various percentages of ultraviolet, blue, green, red, far-red and infra-red radiation or Fluorescent light (FL as a control) on growth of sweet

chestnut seedlings into mini-plug containers during one month indoor cultivation. Leaf characteristics of chestnut seedlings were better promoted under LEDs by means of faster leaf formation of greater area that showed significantly higher stomata and epidermal cell number compared to the FL light. Therefore among LEDs G2, NS1 and AP67 showed the greatest effect by inducing significantly higher stomatal density (SD), stomatal index (SI%) and cell density (CD) compared to the FL light and L20AP67 LED. Similar shoot development was found irrespective the light spectrum, however significantly longer roots were formed by the L20AP67 than the FL light that showed the shortest. Further root system architecture analysis revealed that NS1 and AP673L LEDs produced seedlings with significantly higher root fibrosity index compared to the FL. Dry weight accumulation especially of the shoots and roots of the seedlings treated with the AP673L was the highest by far. In contrast FL light obtained the lowest dry weight mass thus exhibited the lowest R/S ratio compared to LEDs. These results presented, might provide new strategies for using LEDs of continuous spectrum for adequate cultivation protocols into growth chambers of *Castanea sativa* or other forest tree species.

Key words: chestnut, growth chamber, LEDs, light quality, photomorphogenesis.

AGROFORESTRY: A SECURE FUTURE FOR GLOBAL CROP PRODUCTION

Yordanka Stancheva[1*], Krasimira Petkova[2], and Sonya Bencheva[3]

[1]Department of Plant Protection, Faculty of Agronomy, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. [*]E-mail: agroforestry@abv.bg
[2]Department of Silviculture, Faculty of Foresrtry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mail: kpet@abv.bg
[3]Department of Plant Pathology and Chemistry, Faculty of Ecology and Landscape Architecture, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mail: sonben@abv.bg

Agroforestry includes all land-use systems and technologies of production, where perennial woody plants or shrubs, agricultural crops and animals are grown in one and the same area under a certain form of spatial arrangement or consistent timing. It suggests options for sensible combinations of good economic performance and a large number of social and especially environmental benefits. Therefore, considering the negative global climate change, declining soil fertility and loss of biodiversity and habitats, its importance will continue to grow. Due to its multifunctional nature agroforestry can be developed only by a large and multidirectionaly specialized teams such as the one that the University of Forestry in Sofia has. The paper reviews the

work carried out in the field of agroforestry via popularization, education and scientific research. The emphasis is put on the specificity and importance of some lesser-known forms, such as eco-agroforestry and the possibility of its inclusion into the National Plan for Development of organic production. The necessity of institutionalizing this type of production in the entire European community similarly to the organic farming is pointed out. Only then is it possible to elaborate an overall strategy and policy for development of this economic field.

Key words: eco-agroforestry, land-use systems, organic production, educational, popularizing and scientific research.

GYPSY MOTH OUTBREAKS IN FOREST COMPLEXES OF THE JABLANICA REGION (SOUTHERN SERBIA) IN THE PERIOD 1996–2014

Mara Tabakovic-Tosic*, Miroslava Markovic, and Marija Milosavljevic

Department of Forest Protection, Institute of Forestry, 3 Kneza Viseslava str., 11030 Belgrade, Serbia. *E-mail: mara.tabakovic@gmail.com

In the area of the Jablanica Region (Public Enterprise Srbijasume, Forest Estate Leskovac), after the thirty-year period of latency, the significant growth of the gypsy moth population level occurred three times (1996–1997, 2002–2005 and 2011–2014). In the culmination phases, attacked areas were: 22,425 ha (1996), 38,856 ha (2004) and 18,272 ha (2013). The retrogradation phases occurred in the autumn of 1998, 2005 and 2014, so it were the result of the effective aerial control in the larval instar by the microbiological (Foray 48B) and biotechnical (Dimilin SC-48) insecticides as well as of the increased activity of the natural enemies. The analysis of the gypsy moth egg masses was made on a yearly basis. The average number of eggs in the egg mass ranged from 297.7 (1997) to 507.2 (2013). The percentage of the vital eggs in the total number of eggs ranged from 89.5 in 2013 to 97.2 in 2012. Average parasitism of eggs ranged from 2.5 in 2012 to 9.7 % in 2013. The average rates of parasitism should not be taken as final ones, because under these laboratory conditions it is not possible to determine the effect of a series of parasites and predators, to which egg masses are exposed in the field. The dynamics of the hatching of imagos from the previosly analysed egg masses was monitored in the special experiments. Every year only two species of egg parasites *Anastatus japonicus* Ashmead and *Oencyrtus kuwanae* (Howard) were present. Every year the ratio of them was relatively equal (33 : 67 %), with the clear dominance of *O. kuwanae.* In the spring of 2012, 2013 and 2014, the increased mortality rate of the larvae were reported and analyzed. During the field research clear symptoms of disease caused by *Lymantria dispar* multicapsid nuclear polyhedrosis virus (*Ld*MNPV) and

characteristic symptoms of the fungal diseases caused by *Entomophaga maimaiga* Humber, Shimazu, and R. S. Soper were found on dead gypsy moth caterpillars. By the laboratory studies of the causes of the mortality of the gypsy moth larval instars and by the microscopic analysis of the dead caterpillars, the presence of *Ld*MNPV occlusion bodies and the conidiospores and azigospores of the entomopathogenic fungus *E. maimaiga* was confirmed.

Key words: control, egg masses analysis, natural enemyes.

PHENOTYPIC VARIABILITY OF DOUGLAS FIR (*PSEUDOTSUGA MENZIESII* (MIRB.) FRANCO) DURING INTRODUCTION IN BELARUS

Uladzimir Torchyk and Gennady Kholopuk*

Central Botanical Garden of Belarus National Academy of Sciences, 2B Surganova str., 220012 Minsk, Belarus. E-mails: dendro@tut.by, g.holopuk@cbg.org.by*

Finding ways to assess the productivity of exotic species under the new climatic conditions is an important part of the successful introduction of silvicultural practices. The purpose of this research is assessment of intra-population polymorphism in Douglas fir stands on terms of seasonal development, color of female strobila and anther, bark texture (structure). It was found that under seasonal development are distinguished the following phenotypes of plants: very early, early, middle, late and very late; under color of female strobila – green, greenish-brown and purple; color of anther – yellow, orange, purple and brown; bark texture (structure) – deep fissured cork (coarse bark), middle fissured cork (transitional) and shallow fissured cork (plane bark) phenotype. Each of the plants is characterized by a highly individual phenotypic spectrum. The most informative and accessible for practical use were phenotypes on bark structure: coarse bark phenotype – bark cork, light, in the form of massive plates of thickness greater than 5 cm with cavities, divided by deep fissures. At the age of 70–75 years the bark in the butt-log portion gradually peels off and fall to a height of 2–3 m. Instead of the fallen bark actively forms the new one; transitional phenotype – bark is relatively dense, thickness up to 4–5 cm, shaked, middle depth fissures. There is a detachment of the bark at the root collar to a height of 0.7–1.0 m; plane bark phenotype – bark is dense, thin, thickness up to 2–3 cm, small plates, cloven by shallow fissures, not exfoliate. Morphological polymorphism of Douglas fir under bark texture (structure), clearly expressed in the form of introduction populations, notably characterized by growth index. Trees of deep fissured cork (coarse bark) phenotype are considered as the most productive. At the age of 71, their average height is up to 30.8 m, average

diameter – 42.7 cm. Trees of middle fissured cork (transitional) are second to the first one in average inventory indices: height by 8 % and diameter by 20 %. Both phenotypes have a small degree of tapering and a well-developed crown. Trees of shallow fissured cork (plane bark) phenotype rank below in height by 25 % and by 42 % in diameter and are characterized by higher values of variation coefficients. They form a canopy in the second planting as a regrowth. Thus, deep fissured cork (coarse bark) and middle fissured cork (transitional) phenotypes are the most promising for planting. Type of bark can also be a phenome marker and used in plus tree selection.

Key words: bark type, phenotype, productivity.

FOREST FIRE PROTECTION INFRASTRUCTURES IN NATURAL PROTECTED AREAS WITH MANAGEMENT BODY. AN EXISTING SURVEY OF GREECE

Konstantinos S. Tsiolis[1*] and Georgios S. Efthimiou[2]

[1]Forester, Fire Brigade Officer, Mitropoleos 35, 43100 Karditsa, Greece.
*E-mail: kostaskard@hotmail.com
[2]Department of Forestry and Natural Environment Management, Technological Educational Institute of Sterea Hellas, 36100 Karpenisi, Greece. E-mails: gefthi@yahoo.gr, efthimiou@teiste.gr

The recent global climate change has already increased the risk of fire in the Mediterranean forests, including and the protected natural areas. The adaptation options of the fire protection that are related to the forest fires and to the climate change, contain measures which are relative to the management of the biomass, the prevention and the fighting of the fire with the proper infrastructure and mainly with the public sensitization. This research aims to examine the current situation of the above measures, and to evaluate the 28 Management Bodies (M.B.) that are responsible for equal in numbers protected areas of Greece. As a research tool it was used the method of the questionnaires in order to record and to evaluate the views of the land use managers and the scientists in each of the 28 Protected Areas (P.A.). The survey shows differences between the different national parks as regards the fire protection measures, as well as the effectiveness of the firefighting and the public sensitization, which were estimated to be more important than even the management of the fuel biomass. The results were evaluated in the light of a critical review of measures to prevent and manage a fire, with study area the protected areas of Greece, which are managed by the Management Body.

Key words: activity of the M.B., firefighting infrastructures, fire prevention, Mediterranean forests, national park, protection measures.

THE EFFECTS OF MICRO-RELIEF FORMS ON NATURAL REGENERATION AFTER WINDTHROWS IN BULGARIA

Nickolay Tsvetanov[1*], Alexander Dountchev[2], Momchil Panayotov[3], and Stefan Yurukov[4]

Department of Dendrology, University of Forestry, 10 St. Kliment Ohridski blvd., Sofia 1797, Bulgaria. E-mails: nik_tsvetanov@abv.bg*; alexdountchev@hotmail.com; mp2@abv.bg; syurukov@abv.bg

In the last decades large-scale disturbances such as wind storms and the following development of bark beetle outbreaks have affected nearly 1 million hectares of spruce forests in managed and protected areas across all parts of Europe. We studied the influence of micro-relief forms on natural regeneration after two windthrows which occurred 30 (1983) and 50 years ago (1962) in 150+ year old-growth forest in Parangalitsa reserve and a recent large-scale windthrow (2001) in 130-year old uniform forest in Bistrishko branishte reserve in Bulgaria. After large-scale wind-disturbances an increase in the area of micro-relief forms such as Coarse wood debris (CWD), pits and mounds is observed. We registered two discrete peaks (first and second regeneration wave) of post-disturbance regeneration reflecting the changes in the availability of suitable regeneration substrates, as well as the enhanced regeneration capacity and shelter functions of the young forest. In Parangalitsa during the first regeneration wave the main regeneration substrate was intact forest floor (IFF), hosting between 69 and 80% of the regeneration. In the second regeneration wave the importance of CWD for the regeneration rose significantly in comparison to the first wave and supported already 49 % of the regeneration in windthrow-1983 (Wilcoxon Signed Ranked test, $p < 0.001$) and 41 % in windthrow-1962 ($p < 0.001$), while IFF hosted respectively 48 % and 32 % of the regeneration. The CWD proved to be particularly suitable substrate for the recruitment of *Picea abies* (L) Karst. and to a lesser extent of *Abies alba* Mill, accounting for 80 % of the regeneration on this substrate. In Bistrishko branishte no regeneration on CWD was registered due to the lack of dead wood in advanced stage of decay. The proportion of regeneration on pits and mounds remained under 20 % from the total regeneration in both regeneration waves.

Key words: coarse wood debris, disturbances, forest dynamics, Norway spruce, unmanaged forest.

DENDROCHRONOLOGICAL RECONSTRUCTION OF FIRE HISTORY IN PINUS HELDREICHII FORESTS IN PIRIN MOUNTAIN

Pepa Vasileva[1*] and Momchil Panayotov[2]

[1]Faculty of Ecology and Landscape Architecture, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. [*]E-mail: lessage@abv.bg
[2]Department of Dendrology, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mail: mp2@abv.bg

Wildfires play significant role in forest dynamics. Recent and expected climate changes increase the chances for fire events with potential high effects on mountain and lowland ecosystems. It is therefore very important to study the fire history of certain forests. We studied old-growth subalpine forest ecosystems of Pinus heldreichii in Pirin Mts. Despite their high conservational value and the necessity of better knowledge of the species and the ecosystems it composes, many questions are still poorly studied. The aim of our study was to reconstruct the fire history of the investigated region using dendrochronological analysis of fire-scarred trees, as well as to determine fire occurrence frequency. We selected old-growth forests situated in "Dzhindzhiritsa – Baiuvi dupki" Reserve in Pirin Mts. with different stand structures and signs of fires. We collected 150 tree ring cores from fire-scarred trees and unaffected trees located at proximity. All samples were successfully dated using dendrochonological analysis. We found out that there were at least 6 large fires in the last 600 years. The mean fire interval was 73 years. The minimum fire-free interval was 30 years and the maximum – 215 years. An increase in the frequency of wildfires has been observed from the beginning of XVIII century. For all fire years a very high percentage of affected trees were estimated. It varies between 26 % and 75 %, including 5–44 % fire-scarred trees.

Key words: Bulgaria, fire scars, old-growth, *Pinus leucodermis*, subalpine forests, wild fires.

CHARACTERISTICS OF A FOREST COMMUNITY AT THE LOCALITY 'JOZICA KOLIBA' IN SERBIA

Milorad Veselinovic[1*], Suzana Mitrović[1], Dragica Vilotić[2], Nevena Cule[1], Dragana Dražić[1], Snežana Stajić[1], and Snezana Rajkovic[1]

[1]Institute of Forestry, 3 Kneza Višeslava str., 11000 Belgrade, Serbia.
[*]E-mail: mvcetiri@ikomline.net
[2]Faculty of Forestry, University of Belgrade, 1 Kneza Višeslava str., 11000 Belgrade, Serbia.

The memorial area 'Jozica Koliba' is situated within the zone of the forest complex Obrenovački Zabran. A special value of this locality is the natural protected area

'The Pedunculate Oak Tree Group – Jozića Koliba'. Its consists of six Pedunculate oak trees (*Quercus robur* L., syn: *Quercus pedunculata* Erh.) with their horizontal crown projections. The protected tree group represents the remnant of autochthonous Pedunculate oak and ash communities in Serbia (*Querceto-fraxinetum serbicum*). The average age of trees is 200 years. In order to protect the area in the immediate vicinity of representing landscape units we carried out analysis of forest vegetation in the entire area. The study of the recent forest vegetation was carried out following the Braun-Blanquet methodology. Analyzing the presence of life forms in this plant comunity, it is established their phanorophyte-hemicryptophytic character, significant including geophytes. The phytogeographyc analysis of flora reveals the presence of 8 areatypes. The species of Eurasian area type are the most abundant. In the forest community grows protected by law species *Ruscus aculeatus* L. and *Viola odorata* L. For that reason it is necessary to start the process to protect the entire area what would allow those species to become a spatial protected.

Key words: biological spectrum, forest vegetation, natural resources, Obrenovac reserve.

CURRENT STATE OF POPULATIONS AND RESOURCE ASSESSMENT OF *ALCHEMILLA* SPECIES IN WESTERN STARA PLANINA AND WESTERN SREDNA GORA MOUNTAINS IN BULGARIA

Antonina Vitkova[1*], Malina Delcheva[1], Alexander Tashev[2], Dimitar Dimitrov[3], Ina Aneva[1], and Anna Gavrilova[2]

[1]Institute of Biodiversity and Ecosystem research, Bulgarian Academy of Sciences, 23 Acad. G. Bonchev str., 1113 Sofia, Bulgaria. [*]E-mail: avitkova@bio.bas.bg
[2]University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria. E-mails: atashev@mail.bg, any_gavrilova@abv.bg
[3]National Natural History Museum, Bulgarian Academy of Sciences, 1 Tzar Osvoboditel blvd., 1000 Sofia, Bulgaria. E-mail: dimitrov.npm@gmail.com

The genus *Alchemilla* L. comprises 35 species located in Bulgaria, 14 of which are Bulgarian and Balkan endemics. The use of *Alchemila* species in traditional and official medicine is well known. These species are under the special regime for harvesting through annual quotas according to Bulgarian legalization. The main purpose of this study (2010–2012) was to establish the distribution and evaluate resources of *Alchemilla* species outside protected areas. Using the track method 22 populations in Western Stara Planina Mountain and 14 in Western Sredna Gora Mountain were found and studied. The plots method was applied to resource assessment of 5 populations in Western Stara Planina Mt. and 4 in Western Sredna Gora Mt. The location, area,

ecological characterization, type of the plant community, resource and operating reserves of the *Alchemilla* species were established. Thirteen species of *Alchemilla* were found in Western Stara Planina Mt. and nine species in Western Sredna Gora Mt. Two endangered species, namely *Alchemilla achtarowii* (Bulgarian endemic) and *Alchemilla cathachnoa* (Balkan endemic) were detected in surveyed mountains. The operating reserves of *Alchemilla* species in the studied regions of Western Stara Planina Mt. were insignificant.Considerably larger resources in the region of Koprivshtitsa town of Western Sredna Gora Mt. were established.

Key words: Balkan endemics, medicinal plants, operating reserves, protection, resources.

STATE OF THE FOREST COMMUNITIES IN CONDITIONS OF CHANGING ENVIRONMENT ON EUROPEAN NORTH OF THE RUSSIA

Vasily T. Yarmishko* **and Marina A. Yarmishko**

Komarov Botanical Institute, 2 Prof. Popova str., St. Petersburg, 193376, Russia.
*E-mail: vasiliyarmishko@yandex.ru

Boreal forests on European North of the Russia are highly influenced by natural and anthropogenic factors. Among the reasons for state deterioration of the forest ecosystems industrial air pollution is most important. We study permanent trial areas set more than 30 years ago Kola Peninsula where the largest Ni-Cu plant is situated. The goal of research was to estimate the state of *Pinus sylvestris* L. in conditions of changing environment under permanent impact of air pollution. The studies were carried out in lichen-green moss pine forests of III–IV age classes situated in three zones: background, buffer and impacted one. Our results indicate that the index of vital state of tree layer of pine forests varies in the limits of 0.8–0.96 in background areas. Life duration of the needles of *Pinus sylvestris* varies between 5.7 and 6.7 years. 30 years ago in the buffer zone the index of vital state of pine stands was lower (0.76) than it was in background zone, and by 1990 it reached the minimum values (0.53–0.57). The age of the needles on the trees did not exceed 4–5 years. The tree layer in impacted zone was characterized by high grade of depression (the index is 0.29–0.39). It is notable that the state of pine forests tree layer was notably better when there was sharp decreasing of the volumes of eruptions. Nowadays the index of vital state of pine forests is considerably increased, however its value (0.47) is almost 2 times lower than in background conditions. Life duration of the needles in considered zone varies between 1.5 and 4.5 years. In conclusion we note that the state of forest communities in background conditions on European North of the Russia is determined by climate factors and natural succession processes during the

recruitment of the communities after external violations (cuts, fires). The state of forest communities and its components in the buffer and impacted zones depends from the intensity of pollution by toxic wastes from the industry.

Key words: climate, layer, needles, pollution, succession, tree stand.

KINETIC STUDY OF THE ENZYMATIC HYDROLYSIS OF *ROBINIA PSEUDOACACIA* L. FOR BIOETHANOL PRODUCTION

Nikolay Yavorov, Ivo Valchev*, and Stoyko Petrin

Department of Pulp, Paper and Printing Arts, University of Chemical Technology and Metallurgy, 8 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria. *E-mail: ivoval@uctm.edu

The investigation is carried out on preliminary chipped and steam-exploded black locust wood (*Robinia pseudoacacia* L.). The cellulase complex NS 22086 and the β-glucosidase NS 22118 of Novozymes AS are used for the enzymatic hydrolysis. The enzyme hydrolysis to glucose is best described by the modified topochemical equation of Prout-Tompkins. According to this model, the rate of hydrolysis is a function of the amount of product that subsequently becomes soluble (degree of hydrolysis) and of the amount of residual undissolved substrate at any time. The hydrolysis process is starting to take place on the most accessible outer surface of the pulp to proceed further gradually penetrating the capillary system of the fiber pulp matrix. The rate decrease is due to the reduction of the pre-exponential factor, taking into consideration the inhibition of the enzyme from the obtained products.

Key words: black locust wood, steam-explosion, topochemical mechanism, cellulase kinetics.

COMPARATIVE STUDY OF THE GROWTH OF *PINUS NIGRA* AND *CEDRUS ATLANTICA* IN MELNIK REGION

Dobrinka Zakova-Aleksandrova

University of Forestry, 10 Kliment Ohridski blvd., 1797 Sofia, Bulgaria.
E-mail: dobrinka.zakova@gmail.com

The object of the present study are 40-years-old forest plantation of *Pinus nigra* Arn. and *Cedrus atlantica* (Endl.) Manetti ex Carr. within the bounds of Natural Sight “Melnik pyramids”. The groups are with pure structure and they are located in a slopes with the same environmental conditions. For tracking the growth of both tree species was

made an analysis by using one model stem for both species. It traces the growth and the increment in height, thickness and volume of the model trees. The results show significantly better growth and vigor of *Cedrus atlantica*.

Key words: forest plantation, growth rate, model stem.

RESEARCH ON SPATIAL DISTRIBUTION OF UNDER-FOREST ECONOMIC DEVELOPMENT IN CHINA

Caihong Zhang*, Liangzhen Zang, and Lan Zhang

School of Economics and Management, Beijing Forestry University, 35 Qinghua Donglu Haidian District, 100083 Beijing, China. *E-mail: zhangcaihong@263.net

Developing the under-forest economy is an important measure for consolidating the achievements of collective forest right system reform, and an effective form to raise farmers' income, increase job opportunities and promote the change of the pattern of regional economic development in China. The under-forest economic development has a certain difference in different areas because of its conditions and resource endowment, technology, policy environment. The study on the spatial difference and the associated characteristics of the under-forest economic development has an important significance for the construction of the space structure and the division of labor pattern. In this paper, the data of output about under-forest economic development, which contain 28 provinces and have been published in 2012, were used to study the spatial distribution in China. Results showed that the current development of China's under-forest economy presented a phenomenon of faint discrete distribution in general. The appearance of under-forest economic agglomeration of high value regions mainly concentrated in the Northeast and the North, the status of low value regions that are surrounded by high value regions mainly concentrated in central regions. The situation of under-forest economic agglomeration of low value regions mainly concentrated in the Southwest and the Southeast. The case of high value regions that are surrounded by regions of low value mainly concentrated in partial provinces of the Southwest and the Southeast. The forest resources, regional economy and policy on under-forest can make an influence on the spatial distribution of under-forest economy in some extent.

Key words: forest resources, forestry industrial structure, output, regional development, spatial autocorrelation, under-forest economy.

LIST OF PARTICIPANTS

ALGERIA

Hamana MALKI, Agronomic and Veterinary Institute, University Hadj-Lakhdar Batna, Boulevard KL, campus Hadj Lakhdar, 05000 Batna, Algeria, e-mail: malkiham@hotmail.com

AUSTRIA

Tamara ECKHART, Department of Forest and Soil Sciences, Institute of Silviculture, University of Natural Resources and Life Sciences, Peter Jordan Strasse 82, 1190 Vienna, Austria, e-mail: tamara.eckhart@boku.ac.at; Centre for Climate Change Adaptation, alpS GmbH, Grabenweg 68, 6020 Innsbruck, Austria

Myroslava LESIV, International Institute for Applied Systems Analysis, Laxenburg, A-2361, Austria, e-mail: lesiv@iiasa.ac.at; Lviv Polytechnic National University, 79013 Lviv, Ukraine.

Dmitry SCHEPASCHENKO, International Institute for Applied Systems Analysis, Laxenburg, A-2361, Austria, e-mail: schepd@iiasa.ac.at; Moscow State Forest University, Mytischi, 141005 Moscow, Russia.

Dominik THOM, Department of Forest- and Soil Sciences, Institute of Silviculture, University of Natural Resources and Life Sciences Vienna, Peter Jordan Strasse 82, 1190 Vienna, Austria, e-mail: dominik.thom@boku.ac.at

BELARUS

Uladzimir TORCHYK, Central Botanical Garden of Belarus National Academy of Sciences, 2B Surganova str., 220012 Minsk, Belarus, e-mail: dendro@tut.by

BOSNIA AND HERZEGOVINA

Zoran GOVEDAR, Faculty of Forestry, University of Banja Luka, 75 Stepa Stepanovic blvd., 78000 Banja Luka, Republic of Srpska/Bosnia and Herzegovina, e-mail: zoran.govedar@sfbl.org

Dane MARČETA, Faculty of Forestry, University of Banja Luka, 75a Stepe Stepanovica blvd., 78000 Banja Luka, Republic of Srpska, Bosnia and Herzegovina, e-mail: danemarceta@sfbl.org

BULGARIA

Alexandra ALEXANDROVA, Department of Dendrology, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., Sofia 1797, Bulgaria, e-mail: a.v.alexandrova@abv.bg

Svetoslav ANEV, Department of Dendrology, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: svetoslav.anev@gmail.com

Ina ANEVA, Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, Acad. G. Bonchev Street, block 23, 1113 Sofia, Bulgaria, e-mail: ina.aneva@abv.bg

Evlogi ANGELOV, Department of Wildlife Management, University of Forestry, 10 St. Kl. Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: evoangelov@gmail.com

Svetlana ANISIMOVA, Department of Park and Landscape Construction, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: sanisimova@mail.bg

Maria ASENOVA, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., Sofia 1797, Bulgaria, e-mail: m_asenova@abv.bg

Alexander BARDAROV, Department of Silviculture, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: a.bardarov@pdm-services.eu

Maria BROSHTILOVA, Oak Forest Experimental Station, 8008 Burgas, Bulgaria, e-mail: mbroshtilova@abv.bg

Marius DIMITROV, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: mariusdimitrov@abv.bg

Aneliya DIMITROVA, Experimental Station for Fast-Growing Forest Species, 18 Nove str., 5250 Svishtov, Bulgaria, e-mail: elina04@abv.bg

Dinko DINEV, Oak Forest Experimental Station, Izgrev Complex, 8008 Burgas, Bulgaria, e-mail: dinevds@gmail.com

Anna DOBRITCHOVA, University of Forestry, 10 St. Kliment Ohridski blvd., Sofia 1797, Bulgaria, e-mail: ani_dobrichova@abv.bg

Alexander DOUNTCHEV, Department of Dendrology, University of Forestry, 10 St. Kliment Ohridski blvd., Sofia 1797, Bulgaria, e-mail: alexdountchev@hotmail.com

Danail DOYCHEV, University of Forestry, 10 Kliment Ohridski blvd., Sofia 1797, Bulgaria, e-mail: doychev@abv.bg

Emil GALEV, Department of Landscape Architecture, Faculty of Ecology and Landscape Architecture, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: emil.galev@abv.bg

Gradimir GRUYCHEV, Department of Wildlife Management, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: gradi.val@gmail.com

Maria GURKOVA, Department of Landscape Architecture, Faculty of Ecology and Landscape Architecture, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: maria_gurkova@abv.bg

Georgi HINKOV, Department of Silviculture and Management of Forest Resources, Forest Research Institute – BAS, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria, e-mail: georgihi@abv.bg

Nadka IGNATOVA, Department of Plant Pathology and Chemistry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: nadia_ignatova@abv.bg

Nasko ILIEV, Department of Silviculture, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: ilievnasko@abv.bg

Adriana IVANOVA, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: adriana_1111@abv.bg

Albena IVANOVA, Department of Dendrology, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: albenabeti@gmail.com

Velika JORDANOVA, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: veli_jordanova@abv.bg

Vania KACHOVA, Forest Genetics, Physiology and Plantations Department, Forest Research Institute – Bulgarian Academy of Sciences, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria, e-mail: vania-kachova@abv.bg

Konstantinos KOUKOULOMATIS, University of Forestry, 10 St. Kliment Ohridski blvd., 1797, Sofia, Bulgaria, e-mail: bombardier415@yahoo.gr

Aneta LYUBENOVA, AgroBioInstitute, 8 Dragan Tsankov blvd., 1164 Sofia, Bulgaria, e-mail: anetta7@abv.bg

Milko MILEV, Department of Silviculture, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: m_milev@abv.bg

Radoslav MILTCHEV, Department of Computer Systems and Informatics, Faculty of Business Management, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: rmiltchev@abv.bg

Ibrahim MOLLA, Department of Forest Ecology, Forest Research Institute – BAS, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria, e-mail: mollata@abv.bg

Lora NAYDENOVA, Department of Forest Ecology, Forest Research Institute – BAS, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria, e-mail: l.naydenova@gmail.com

Teodor NEDELIN, Department of Silviculture, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: teodor_nedelin@hotmail.com

Nikolay NEYKOV, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: nkneykov@gmail.com

Ivailo NIKOLOV, Directorate Central Balkan National Park, 3 Bodra smyana str., 5300 Gabrovo, Bulgaria, e-mail: ivodimnik@abv.bg

Ivan PALIGOROV, Faculty of Business Management, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: ipaligorov@abv.bg

Momchil PANAYOTOV, Department of Dendrology, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: mp2@abv.bg

Panayot PANAYOTOV, Faculty of Forest Industry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mails: ppanayotov45@abv.bg, ppanayotov@dir.bg

Pavel PAVLOV, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: pavelppj@googlemail.com

Aneliya PENCHEVA, Department of Plant Pathology and Chemistry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: ajp84@abv.bg

Krasimira PETKOVA, Department of Silviculture, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: kpet@abv.bg

Rumen PETRIN, Forest Research Institute – Bulgarian Academy of Sciences, 132 St. Kliment Ohridski blvd., Sofia 1756, Bulgaria, e-mail: lesni4eja2013@gmail.com

Stoyko PETRIN, Department of Pulp, Paper and Printing Arts, University of Chemical Technology and Metallurgy, 8 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria, e-mail: stoiko_petrin@abv.bg

Emil POPOV, Department of Forest genetics, physiology and plantation forests, Forest Research Institute – BAS, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria, e-mail: emilpopov99@hotmail.com

Yavor PORYAZOV, Department Forest management, University of Forestry, 10 St. Kliment Ohridski blvd, 1797 Sofia, Bulgaria, e-mail: yavoracer@abv.bg

Ivan RAEV, Forest Research Institute, Bulgarian Academy of Sciences, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria, e-mail: ivan_raev@yahoo.com

Slavcho SAVEV, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: ssavev@abv.bg

Veselin SHAHANOV, Department of Park and Landscape Design, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: vshahanov@yahoo.com

Yordanka STANCHEVA, Department of Plant Protection, Faculty of Agronomy, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: agroforestry@abv.bg

Alexander TASHEV, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: atashev@mail.bg

Toma TONCHEV, Department Forest management, University of Forestry, 1797 Sofia, 10 St. Kliment Ohridski blvd, Bulgaria, e-mail: toma_tonchev@yahoo.com

Lyubcho TRICHKOV, Executive Forest Agency, 55 Hristo Botev blvd., 1040 Sofia, Bulgaria, e-mail: lptrichkov@iag.bg

Evgeni TSAVKOV, Department of Dendrology, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: tsavkov@abv.bg

Nickolay TSVETANOV, Department of Dendrology, University of Forestry, 10 St. Kliment Ohridski blvd., Sofia 1797, Bulgaria, e-mail: nik_tsvetanov@abv.bg

Ivaylo TSVETKOV, Forest Research Institute – BAS, 132 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria, e-mail: tsvet_i@yahoo.com

Nikolina TZVETKOVA, Department of Dendrology, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: nikolina_tzvetkova@mail.bg

Elizabet VACHKOVA, Faculty of Business Management, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: evatchkova@ibset.eu

Ivo VALCHEV, Department of Pulp, Paper and Printing Arts, University of Chemical Technology and Metallurgy, 8 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria, e-mail: ivoval@uctm.edu

Lyubka VARBEVA, Department of Silviculture, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: lubka.varbeva@gmail.com

Pepa VASILEVA, Department of Ecology, Protection and Remediation of the Environment, Faculty of Ecology and Landscape Architecture, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: lessage@abv.bg

Evgenia VELINOVA, Department of Dendrology, Faculty of Forestry, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: pancheva.evgeniya@gmail.com

Nikolay YAVOROV, Department of Pulp, Paper and Printing Arts, University of Chemical Technology and Metallurgy, 8 St. Kliment Ohridski blvd., 1756 Sofia, Bulgaria. e-mail: nyavorof@gmail.com

Mariya YOVKOVA, Institute of Ornamental Plants, Negovan, 1222 Sofia, Bulgaria, e-mail: mariya_yovkova@abv.bg

Stefan YURUKOV, Department of Dendrology, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: syurukov@abv.bg

Nikolay ZAFIROV, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: niki.zafirov@gmail.com

Dobrinka ZAKOVA-ALEKSANDROVA, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: dobrinka.zakova@gmail.com

Petar ZHELEV, University of Forestry, 10 St. Kliment Ohridski blvd., 1797 Sofia, Bulgaria, e-mail: zhelev@ltu.bg

CHINA

Wenhui CHEN, School of Economics & Management, Beijing Forestry University, 100083 Beijing, China, e-mails: wenhui@bjfu.edu.cn, chenwenhui77@163.com

Caihong ZHANG, School of Economics and Management, Beijing Forestry University, 35 Qinghua Donglu Haidian District, 100083 Beijing, China, e-mail: zhangcaihong@263.net

CZECH REPUBLIC

Seyed Mohammad HOSSEINI, Department of Forest Harvesting, Czech University of Life Sciences, Kamýcká 1176, Prague, CZ – 165 21, Czech Republic, e-mail: s_hosseini99@yahoo.com

Polina LEMENKOVA, Faculty of Science, Institute for Environmental Studies, Charles University in Prague, 2 Benatska str., 12843 Praha 2, Czech Republic, e-mail: pauline.lemenkova@gmail.com

Radim MATULA, Department of Forest Botany, Dendrology and Geobiocoenology, Faculty of Forestry and Wood Technology, Mendel University in Brno, 3 Zemědělská str., 613 00 Brno, Czech Republic, e-mail: radim.matula@mendelu.cz

FINLAND

Marcus LINDNER, European Forest Institute, Yliopistokatu 6, 80100 Joensuu, Finland, e-mail: marcus.lindner@efi.int

FRANCE

Jean-Luc PEYRON, Ecofor, 42 Scheffer str., 75.116, Paris, France, e-mail: jean-luc.peyron@gip-ecofor.org

GERMANY

Wolfgang BECK, Thünen Institute for Forest Ecosystems, Alfred-Moeller-Strasse 1, Eberswalde, 16225, Germany, e-mail: wolfgang.beck@ti.bund.de

Gerhard HUBER, Bayerisches Amt für forstliche Saat- und Pflanzenzucht, Forstamtsplatz 1, 83317 Teisendorf, Germany, e-mail: gerhard.huber@asp.bayern.de

Monika KONNERT, Bayerisches Amt für forstliche Saat- und Pflanzenzucht, Forstamtsplatz 1, 83317 Teisendorf, Germany, e-mail: monika.konnert@asp.bayern.de

Ioannis MITSOPOULOS, The Global Fire Monitoring Center, Fire Ecology Research Group, c/o Freiburg University, Georges-Köhler-Allee 75, 79110 Freiburg, Germany, e-mail: ioanmits@gmail.com

Jürgen MÜLLER, Thünen-Institute, Institute of Forest Ecosystems, Alfred-Möller Strasse 1, 16225 Eberswalde, Germany, e-mail: juergen.mueller@ti.bund.de

Bernd STIMM, Institute of Silviculture, TUM School of Life Sciences Weihenstephan, Technische Universität München, Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, Germany, e-mail: stimm@forst.wzw.tum.de

Michael WEBER, Institute of Silviculture, TUM School of Life Sciences Weihenstephan, Technische Universität München, Hans-Carl-von-Carlowitz-Platz 2, 85354 Freising, Germany, e-mail: m.weber@forst.wzw.tum.de

GREECE

Maria BATZIOU, Department of Forestry and Management of the Environment and Natural Resources, Democritus University of Thrace, Pandazidou 193, 68200 Orestiada, Greece, e-mail: batzioumaria@gmail.com

Georgios EFTHIMIOU, Department of Forestry & Natural Environment Management, Technological Educational Institute of Sterea Hellas, 36100 Karpenisi, Greece, e-mails: efthimiou@teiste.gr, gefthi@yahoo.gr

Kyriaki KITIKIDOU, Department of Forestry and Management of the Environment and Natural Resources, Democritus University, 193 Pantazidou str., 68200 Orestiada, Greece, e-mail: kkitikid@fmenr.duth.gr

Konstantinos MARTINOS, Laboratory of Agronomy and Applied Crop Physiology, Department of Agriculture, Crop Production and Rural Environment, University of Thessaly, Fytokoy str., 38446, N. Ionia, Magnisia, Volos, Greece, e-mail: kmartinos@uth.gr

Elias MILIOS, Department of Forestry and Management of the Environment and Natural Resources, Democritus University of Thrace, Pandazidou 193, 68200 Orestiada, Greece, e-mail: emilios@fmenr.duth.gr

Elias PIPINIS, Laboratory of Silviculture, Department of Forestry and Natural Environment, Aristotle University of Thessaloniki, P.O. Box 262, 54124 Thessaloniki, Greece, e-mail: epipinis@for.auth.gr

Yannis RAFTOYANNIS, Department of Forestry, Technological Educational Institute of Lamia, 36100 Karpenisi, Greece, e-mail: rafto@teilam.gr

Sonia SMIRNAKOU, Department of Forestry and Management of Environment and Natural Resources, Democritus University of Thrace, Pandazidou 193, 68200 Orestiada, Greece, e-mail: sosmirnakou@gmail.com

Petros A. TSIORAS, Laboratory of Forest Utilization, Department of Forestry and Natural Environment, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece, e-mail: ptsioras@for.auth.gr

INDIA

Kulbhushan BALOONI, Indian Institute of Management Kozhikode, IIMK Campus PO, Kozhikode, 673570, India, e-mail: kbalooni@yahoo.com

IRAN

Rokhsareh ARMOON, Science and Research Branch, Faculty of Humanities, Ismalic Azad University, Bolvar e Hesarak, P.O.Box: 775/14515, Tehran, Iran, e-mail: rchoob@yahoo.com

Jahangir FEGHHI, Department of Forestry and Forest Economics, Faculty of Natural Resources, University of Tehran, Karaj, Postal code: 4111, Iran, e-mail: jfeghhi@ut.ac.ir

Fatemeh MOUSAVI, Department of Forestry, Faculty of Natural Resources, University of Tehran, Emamzade Hassan Avenue, Karaj, Postal Code: 4111, Iran, e-mail: fmusavi@ut.ac.ir

Fardin MORADZADEH, Department of Forestry, Faculty of Natural Resources, University of Tehran, Emamzade Hassan Avenue, Karaj, Postal Code: 4111, Iran, e-mail: f_moradzadh@ut.ac.ir

Bahram NASERI, Department of Forestry, Faculty of Natural resources and marine science, Tarbiat Modares University, 76489-46417, Noor, Iran, e-mail: bnasery@gmail.com

Koroush NAZARPOUR, Department of Forestry, Faculty of Natural Resources, University of Tehran, Emamzade Hassan Avenue, Karaj, Postal Code: 4111, Iran, e-mail: knazarpoor@ut.ac.ir

Javad Eshaghi RAD, Department of Forestry, Faculty of Natural resources, Urmia University, P.O. Box 165, Sero blvd., Urmia, Iran, e-mail: javad.eshaghi@yahoo.com

ITALY

Paolo CANTIANI, Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria – Research Centre for Forest Ecology and Silviculture (CRA-SEL), Via S. Margherita 80, 52100 Arezzo, Italy, e-mails: paolo.cantiani@ricercaforestale.it, paolo.cantiani@entecra.it

Isabella DE MEO, Consiglio per la Ricerca in Agricoltura e l'analisi dell'economia agraria – Agrobiology and Pedology Centre (CRA-ABP), P.za D'Azeglio 30, 50121 Firenze, Italy, e-mail: isabella.demeo@entecra.it

Tatiana MARRAS, AgroForestry, Nature and Energy Department (DAFNE), Università della Tuscia, Via S. Camillo de Lellis, snc, 01100 Viterbo, Italy, e-mail: tatianamarras@unitus.it

Federico VESSELLA, AgroForestry, Nature and Energy Department (DAFNE), Università della Tuscia, Via S. Camillo de Lellis, snc, 01100 Viterbo, Italy, e-mail: vessella@unitus.it

LEBANON

Jean STEPHAN, Senior Program Assistant at FAO, Lebanese University, Lebanon, e-mail: dr.jeanstephan@gmail.com

NIGERIA

Agbaeze Umazi UDEAGHA, Department of Agriculture, Hussaini Adamu Federal Polytechnic, Kazaure, Jigawa State, Nigeria, e-mails: aumazi@yahoo.co.uk, uumazi@gmail.com; Department of Forestry and wildlife, University of Uyo, Uyo, Akwa Ibom State, Nigeria; Nigerian Environmental Study Action Team, NEST House, 1 Oluokun Street, Off Awolowo, Bodija, Ibadan, Oyo State, Nigeria.

POLAND

Katarzyna DUDEK, Department of Forest Ecology and Reclamation, Institute of Forest Ecology and Silviculture, Faculty of Forestry, University of Agriculture in Kraków, Al. 29 Listopada 46, 31-425 Kraków, Poland, e-mail: k.dudek@ur.krakow.pl

Marcin PIETRZYKOWSKI, Department of Forest Ecology and Reclamation, Institute of Ecology and Silviculture, Faculty of Forestry, University of Agriculture in Krakow, Al. 29 Listopada 46, 31-425 Kraków, Poland, e-mail: rlpietrz@cyf-kr.edu.pl

REPUBLIC OF MACEDONIA

Jane ACEVSKI1, Faculty of Forestry, Ss. Cyril and Methodius University in Skopje, 1 Makedonska brigada 16 str., P.O. Box 235, MK-1000 Skopje, Republic of Macedonia, e-mail: jacevski@sf.ukim.edu.mk

Vlatko ANDONOVSKI, Faculty of Forestry, Ss. Cyril and Methodius University in Skopje, 1 Makedonska brigada 16 str., P.O. Box 235, MK-1000 Skopje, Republic of Macedonia, e-mail: v.andonovski@makmontana.org

Dejan MANDŽUKOVSKI, Public Enterprise "Makedonski sumi", 128 Pero Nakov str., MK-1000 Skopje, Republic of Macedonia, e-mail: d_mandzukovski@yahoo.com

Kole VASILEVSKI, Ss. Cyril and Methodius University in Skopje, Krste Misirkov bb blvd., 1000 Skopje, Republic of Macedonia, e-mail: k.vasilevski@ukim.edu.mk

Nikolčo VELKOVSKI, Faculty of Forestry, Ss. Cyril and Methodius University in Skopje, 1 Makedonska brigada 16 str., P.O. Box 235, MK-1000 Skopje, Republic of Macedonia, e-mail: nvelkovski@sf.ukim.edu.mk

RUSSIA

Daria K. DIYAROVA, Ural Federal University named after the first President of Russia B.N. Yeltsin, 19 Mira str., 620002 Ekaterinburg, Russia, e-mail: dasha_d@ipae.uran.ru

Galina B. KOLGANIKHINA, Moscow State Forest University, 1 1st Institutskaya str., 141005 Mytischy, Moscow region, Russia; Institute of Forest Science RAS, 21 Sovetskaya str., 143030, vil. Uspenskoye, Odintsovo area, Moscow region, Russia, e-mail: kolganihina@rambler.ru

Elena M. LAPTEVA, Soil Science Department, Institute of Biology Komi SC UrD RAS; 28 Kommunisticheskaya str., 167982 Syktyvkar, Russia, e-mail: lapteva@ib.komisc.ru

Victor A. MUKHIN, Ural Federal University named after the first President of Russia B.N. Yeltsin, 19 Mira str., 620002 Ekaterinburg, Russia, e-mail: victor.mukhin@ipae.uran.ru

Galina A. NOVITSKAYA, Russian Social State University, Moscow, 129226, Russia, e-mail: galina-novitskaya@mail.ru

Tamara SEDELNIKOVA, V. N. Sukachev Institute of Forest SB RAS, Akademgorodok 50/28, Krasnoyarsk, 660036, Russia, e-mail: tss@ksc.krasn.ru

Valentin S. SHALAEV, Institute for Forest System Researches, Moscow State Forest University, 1-st Institutskaya street, 1, Mytishchi-5, Moscow Region, 141005, Russia, e-mail: shalaev@mgul.ac.ru

Tatyana SIZONENKO, Department of Forest Biology Problems of the North, Institute of Biology of Komi, Scientific Centre of the Ural Branch of the Russian Academy of Sciences, 28 Kommunisticheskaya str., 167982 Syktyvkar, Russia, e-mail: tvor.83@mail.ru

Yulia A. VINOGRADOVA, Soil Science Department, Institute of Biology Komi SC UrD RAS, 28 Kommunisticheskaya str., 167982 Syktyvkar, Russia, e-mail: vinogradova@ib.komisc.ru

Vasily T. YARMISHKO, Komarov Botanical Institute, 2 Prof. Popova str., St. Petersburg, 193376, Russia, e-mail: vasiliyarmishko@yandex.ru

SERBIA

Dragan KARADŽIĆ, Faculty of Forestry, University of Belgrade, 1 Kneza Višeslava str., 11030 Belgrade, Serbia, e-mail: dragan.karadzic@sfb.bg.ac.rs

Miroslava MARKOVIC, Institute for Forestry, 3 Kneza Viseslava str., 11030 Belgrade, Serbia, e-mail: mira013@gmail.com

Milan MEDAREVIĆ, Department of Forest Management, Faculty of Forestry, University of Belgrade, 1 Kneza Višeslava str., 11030 Belgrade, Serbia, e-mail: milan.medarevic@sfb.bg.ac.rs

Ivan MILENKOVIĆ, Institute of Forestry, 3 Kneza Višeslava str., 11030 Belgrade, Serbia, e-mail: ivan.milenkovic@sfb.bg.ac.rs

Saša PEKEČ, Institute of Lowland Forestry and Environment, 13 Antona Cehova str., 21000 Novi Sad, Serbia, e-mail: pekecs@uns.ac.rs

Andrej PILIPOVIĆ, Institute of lowland Forestry and Environment, University of Novi Sad, 13 Antona Cehova str., 21000 Novi Sad, Serbia, e-mail: andrejpilipovic@yahoo.com

Snezana RAJKOVIĆ, Institute of Forestry, 3 Kneza Viseslava Str., Belgrade, 11030, Serbia, e-mail: srajkovic1@gmail.com

Mara TABAKOVIC-TOSIC, Department of Forest Protection, Institute of Forestry, 3 Kneza Viseslava str., 11030 Belgrade, Serbia, e-mail: mara.tabakovic@gmail.com

Milorad VESELINOVIĆ, Institute of Forestry, 3 Kneza Višeslava str., 11000 Belgrade, Serbia, e-mail: mvcetiri@ikomline.net

TAIWAN

Shyue-Cherng LIAW, Department of Geography, National Taiwan Normal University, 10610 Taipei, Taiwan, e-mail: liaw@ntnu.edu.tw

TURKEY

Sezgin AYAN, Department of Silviculture, Faculty of Foresrtry, Kastamonu University, 37100 Kuzeykent, Kastamonu, Turkey, e-mail: sezginayan@gmail.com

UNITED KINGDOM

Sizwe MABASO, Earth Observation and Ecosystem Dynamics Laboratory, Aberystwyth University, Wales, United Kingdom, e-mail: sdm5@aber.ac.uk

USA

Chelsea Cervantes De Blois, University of Minnesota, USA, e-mail: cervantes@uwalumni.com

Donald L. GREBNER, Department of Forestry, Mississippi State University, Box 9681, Mississippi State, MS, USA, e-mail: don.grebner@msstate.edu

Donald G. HODGES, Natural Resources Policy Center, University of Tennessee, 274 Ellington Plant Sciences Bldg., Knoxville, Tennessee 37996-4563, USA, e-mail: dhodges2@utk.edu

Peter KITIN, Department of Bacteriology, University of Wisconsin, 1550 Linden Dr. Madison, WI 53706. USA, e-mail: kitin@wisc.edu

Kevin L. O'HARA, University of California, Berkeley, CA 94720-3114, USA, e-mail: kohara@berkeley.edu

Karl ZELLER, N&T Services LLC, Fort Collins CO, USA, e-mail: kzeller@colostate.edu

AUTHOR INDEX