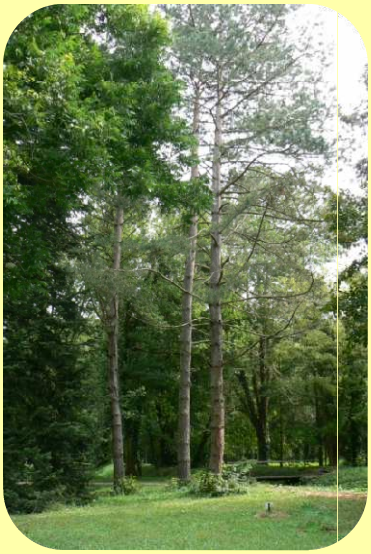
ProCoGen

ProCoGen Dissemination Workshop
Sep. 1st -3rd 2014
Kámoni Arboretum, Szombathely, Hungary

"Genomics and the conservation of conifer genetic resources"

Short Report

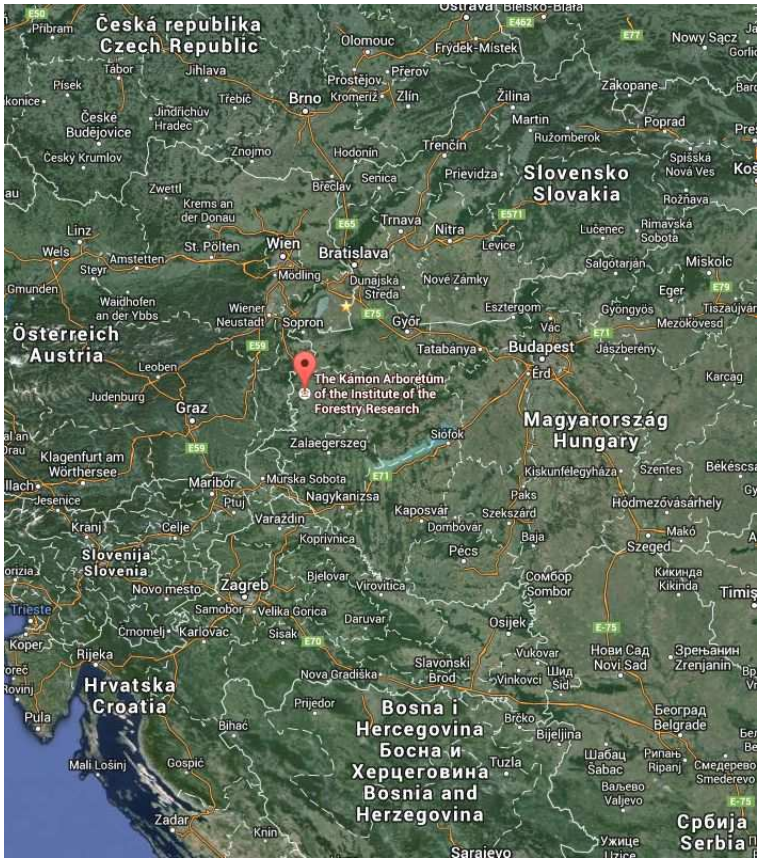
The ProCoGen project is financially supported by the European commission under the 7th Framework Programme



ProCoGen dissemination workshops are organised with the aim of promoting a constant flux of information among the scientific community, so that young and upcoming scientists can profit from the research findings of this international multidisciplinary project.

The second dissemination workshop was held in Szombathely, Hungary from 1st – 3rd of Sep. 2014. It was an effort to interact with stakeholder from the forest based industry sector, as well as young researchers and scientist from EU countries not involved in this project, with special focus on the Central-Eastern European region.

Kamoni Arboretum location



The workshop was attended by 30 people out of these 15 were participants from six different countries and the rest were speakers and organisers.

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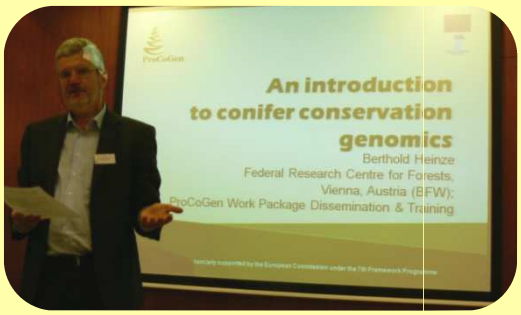
After registration in the forenoon the workshop began with an opening lecture by Dr. Berthold Heinze (Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW) Austria) on: "**Genomics and conifer conservation- a general introduction".** He gave a brief overview of conifers and introduced the audience to conifer genome evolution with focus on molecular research on conifers. The lecture also covered concepts of conifer genomics and, methods and techniques involved. He also gave an account of conservation genomics its meaning and implications for conifers.



Dr. Vedhu Krystufek (Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW) Austria) gave a short introduction of ProCoGen project.

As this workshop was in collaboration with the FP7 FORGER project, Dr. Giovanni Giuseppe Vendramin (Institute of Plant Genetics- Florence, Italian National Council of Research (IGV-FI/CNR) Italy), who is also an active partner on this project, gave a short introduction about FORGER. He explained the importance of data management of forest genetic resources and its impact on forest management in Europe

Approach to conservation human intervention or nature-close forest management- was discussed in the lecture by Dr. Csaba Mátyás (University of West Hungary, Inst. of Environmental and Earth Sciences (NymE) Hungary): "**Challenges of climate changes for conservation of genetic resources".** He presented his studies on thermal stress that poses the greatest challenge to tree adaptation. The beginning of his study dated back to 1968 when 1100 IUFRO provenance trials of Norway spruce were set up in 20 different locations in 13 different countries to investigate the variation within Norway spruce as well as selection for seed supply, and breeding material for tree improvement. Dr. Mátyás presented the results of his experiments on the IUFRO provenance trials that were located in Hungary. After the first clone yield in these provenance trials in 1985 the first progeny test was conducted. The offspring originated from open pollination. Therefore, it was assumed that the adaptability of the progenies would show a great variation than within family.

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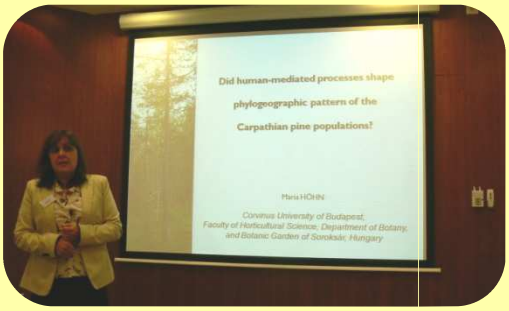

The main objectives were the implications of selection in a provenance trial and comparison of performance of the progenies of selected mother trees that originate from geographically distant sites and from different ecologic environments with that of the local control. As the selection was done for both superior and inferior phenotypes in the provenance test, it was also of interest to see how well these characteristics were inherited by the progeny.

Dr. Mária Höhn (Corvinus University Budapest, Department of Botany, Hungary) spoke about post glacial distribution of pine in the Carpathian region and the effect of anthropogenic activities: pasturing, mining, wood industry & forest management on distribution pattern of pine species in her lecture on: **"Did human mediated processes shape phylogeographic pattern of Carpathian pine populations?"** She also presented two case studies on*: Pinus cembra* and *Pinus sylvestris*. She concluded by emphasizing the importance of understanding the geological pattern, human intervention along with genetic studies for a holistic approach to breeding and management.

The closing lecture on day one was by Dr. Giovanni Giuseppe Vendramin (Institute of Plant Genetics-Florence, Italian National Council of Research (IGV-FI/CNR) Italy): "**Dissecting the role of demography and natural selection in shaping population genetic structure in conifers".** He explained how global climate change especially increase in temperature and change in annual precipitation affects the distribution pattern of forest tree species e.g.: (a) oak distribution modeling using BIOMOD helps predict loss and gain of habitat under the influence of global climate change. (b) *Fagus* distribution study in France in the carbofor project. Climate predictions for southern Europe make the Mediterranean region a threatened hotspot of diversity. The forests cope with abiotic stress through plasticity, adaptation and dispersal.

Then he spoke about phylogeography and the use of markers for the same. To elaborated, he presented a study conducted by Magri et al. published in 2007 on population pools of species that were connected by gene flow. He

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also presented some results of the CYTOFOR project. It involved a multi species (22) population genetics and phylogeographic survey of trees and shrubs across Europe to reconstruct the history using molecular markers and fossils, and to bridge the gap between ecosystem orientated biodiversity studies and species orientated population genetics studies. He presented results of intra- and interspecific population differences found in case studies: identification of refugia and phylogeoraphic distribution patterns.

Another case study on *Pinus pinea* was presented to show the affect of human influence on distribution pattern.

As the rate of spread of forest is predicted to be lower than would be required to keep pace with future climate warming, forest would have to adapt *in situ* for survival. Therefore, understanding past adaptation and genetic response to climate change become essential. In this context he explained the usefulness of common garden experiments in case of Mediterranean conifer species especially for association genetics. He illustrated the application of molecular approach to understand local adaptation, distribution and traits involved in adaptation by presenting results from case studies on pine species. Local adaptation was elaborated further by two more case studies on adaptation along an altitudinal gradient on *Fagus sylvatica* and *Abies alba*.

Day one concluded with a short open forum, which was postponed until the end of day two due to shortage of time: Dr. Silvia Fluch gave a short presentation on resource centre open access and data storage for future. Continuation of the Evoltree project: repository centre.

Day two started with an excursion to the clone bank of Kisunyom which was established in 1965-1968. Currently, there are 4 domestic and 6 European clone-groups with 680 individual clones in this collection. *Pinus nigra* and *P. sylvestris* were the main species represented in this collection. The seeds from this collection have also been used for progeny trials as the entire collection is grafted. The second site visited was the seed orchard complex of the Szombathely Forestry Corp., Acsád. The last stop was an old Oak mixed stand in Farkas-erdő (wolf forest) from Káld to Bejcgyertyános. The excursion gave a good overview of forestry improvement material, and an insight into some aspects of Hungarian silviculture.

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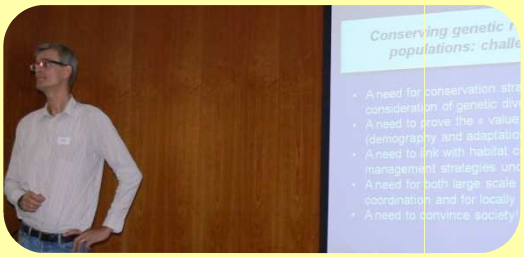
The excursion to the Kámoni Arboretum was postponed due to bad weather.

The afternoon session started with a lecture by Klára Cseke (Hungarian Forest Research Institute (ERTI)) on: "**Hybridization and recruitment in a mixed stand with 3 different oak species".** She explained the molecular genetics of white oaks at species and population levels. Her marker based study, which was conducted as a part of the OAKFLOW project, helped in understanding the geneflow, extent of introgression and hybridization and genetic structure of three species complexes. She explained how these findings could help in formulating apt conservation and forest management strategies.

Genomics and conservation of conifer genetic resources was then highlighted by Dr. Bruno Fady (French National Institute for Agricultural Research (INRA) Avignon, France) in his presentation on: "**Conservation of genetic resources: European stragety and a case study".** The first part of the lecture was dedicated to *in situ* conservation: with a holistic approach, considering aspect of genetic diversity and evolutionary history. Referring to different case studies he explained how populations have different adaptive properties along with different evolutionary histories, because of which adaptation should be an additional aspect to be considered apart from demography and evolutionary history for correct sampling of genetic diversity. Sustainable *in situ* conservation based on science involves setting up of a network of conservation units, this was explained using an example of the genetic resources conservation network in France for *Abies alba*. He further explained features and management of such conservation units e.g. the French conservation unit register for widely occurring species. At a pan-European dimension he presented the EUFORGEN approach to forest resource management (FRM) and streamlining of national forest genetic resource (FGR) conservation strategies at European level. The EUFORGIS database that contains 2774 conservation units and 98 tree species in 31 countries which is also a part of the Europe-wide *in situ* conservation programme.



Applicability of *ex situ* conservation was also explained based on several examples. A case study was presented on an integrated FGR conservation and sustainable use program for *Pinus nigra salzmanni* which was based on genetic marker approach to phylogeny, evolutionary history, demography and adaptation.

Dr. Stephen Cavers (Centre for Ecology and Hydrology (CEH) UK) presented: "**Conifer case studies"** with main

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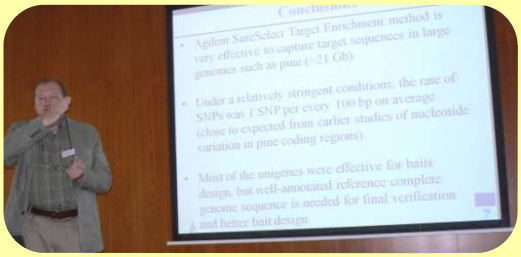

focus on genetic resource conservation of Scottish *Pinus sylvestris*: involving extensive progeny trials. The study was multidisciplinary aiming at meaningful conservation and restoration. It covered demographic history, historical & evolution drivers of genetic variation, population studies, phenotypic variation and its genetic basis in *Pinus sylvestris*. It was further extended to comparative genomics of *P. sylvestris* and *P. mugo* complex also including genome screening to find potential genes for local adaptation and speciation. He concluded with future perspectives linked to whole transcriptome screening for development of novel genomic resources.

This presentation was followed by an open session where all the participants introduced themselves by turn. They gave their views and feedback about the workshop.

The afternoon session ended on a cheerful note after an informal and humorous presentation by Dr. Csaba Mátyás (University of West Hungary, Inst. of Environmental and Earth Sciences (NymE) Hungary): "**Hungary and Hungarians- some witty anecdotes".**

The third day session began with a lecture by Dr. Konstantin Krutovsky (Georg August University of Göttingen, Dept. of Forest Genetics and Forest Tree Breeding, Germany) on: "**Sequencing and conservation genomics".** He first gave an outline about conservation in forestry and explained the conceptual difference between conservation genetics and conservation genomics. He talked about the technological advancements that have revolutionised sequencing genomics. How these could aid in addressing several conservation problems more effectively. For instance by incooperating information about adaptive genes and gene expression for a better understanding of the genetic basis of adaptation, which would support establishment of functionally relevant conservation units and science based conservation measures. He addressed the multidisciplinary approach being followed on whole genome sequencing projects. He explained this using case studies of loblolly pine, where next generation sequencing methods are being applied to understand genotype, phenotype and environment interactions. These case studies were based on two projects funded by USDA: CTGN (Conifer Translational Genomics Network) and PINEMAP (Integrating research, education and extension for enhancing southern pine climate change mitigation and adaptation). The former focused on ecological and population genomic aspects of loblolly pine and the latter on genotyping by sequencing to understand adaptive genetic variation.

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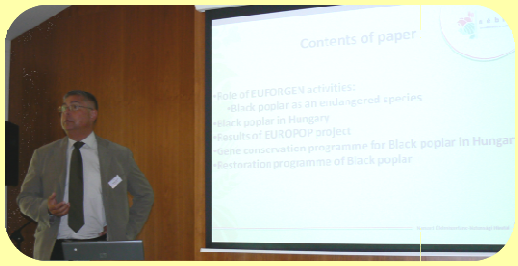

He also presented initial findings from the Siberian pine and larch project.

Gunnar Jansson (Skogforsk, Uppsala Science Park, Uppsala, Sweden) spoke about: "**Swedish programme for conifer conservation and breeding".** He gave an overview of the Swedish forest breeding strategy and programme. The breeding lies in the hands of Skogforsk and forest land owners are responsible for seed orchards. The breeding programme is research based and incooperates adaptation to climate change as well as conservation of genetic resources. Conservation is long term based and involves both *in situ* as well as *ex situ*. The latter half of the talk was devoted to the sustainable Swedish long term breeding programme for forest tree species which aims at maintaining genetic diversity and conserving natural resources for better yield and well -adapted forests

The afternoon session commenced after lunch with a short guided tour of the Kámoni arboretum, which was established at the end of the 19th century by István Saághy. It harbours about 3000 taxa and also a clone collection *P. sylvestris.*

The lecture session continued with a presentation by Dr. Sándor Bordács (National Food Chain Safety Office (NÉBIH), Hungary) on: "**Restoration of rare or endangered species based on examples of black poplar".** He presented a case study of eco restoration and, *in* -& *ex situ* conservation of black poplars. Role of EUFORGEN network in establishing technical guidline, *in situ* conservation strategies and monograph on black poplars. He also gave an outline of gene conservation and management strategy for *Populus nigra* in Hungary. He presented the systematically planned *ex situ* conservation programme for black poplar conservation: starting with selection, approval and certification of FRM (forest reproductive material). Systematic documentation of the genetic material for breeding and propagation. Application of molecular markers for testing. Establishment of e*x situ* gene collection and conservation stands throughout Hungary. Re-afforestation using certified reproductive material from clone collection.The fact that the results from old EU projects were being applied for gene conservation and restoration was remarkable.

The workshop concluded with a presentation by Dr. Kurt Ramskogler (LIECO GmbH & Co KG, Austria) on: "**Genetics in a commercial conifer nursery and practicing forestry".** After a brief introduction to LIECO, which is a pioneer of containerised forest seedlings in middle Europe, he talked

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about forestry practices in Austria: forestry laws, silviculture practices, and selection of provenances for breeding material acquirement. He discussed the present situation in seed production and forest reproductive material and pointed out the gap of knowledge that exists. He shed light on the consequences of climate change on the forest based industry.

He emphasised the importance of integrating genetic research in middle Europe, like being practiced in countries like Sweden and Poland, in order to secure forest resources for the future. He mentioned some measures that should be taken to revise forest tree breeding practices for a high yielding and sustainable forestry especially by integrating the state of the art research in genomics and tree breeding that could help the forestry based sector e.g. as being employed by the Arborgen company based in the USA.

In the end certificates of participation were handed out to each participant to culminate the event.

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ProCoGen Dissemination Workshop 1st – 3rd September 2014

Kámoni Arboretum, Szombathely, Hungary

"Genomics and the conservation of conifer genetic resources"

1st Sep. 2014

9:00 – 12:00 Arrival & Registration

Lunch break

13:00 – 13:30 Berthold Heinze (Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW) Austria): **Genomics and conifer conservation- a general introduction**

13:30 – 14:00 Vedhu Krystufek (Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW) Austria): **ProCoGen- a short introduction and highlights**

14:00 – 14:10 Giovanni Giuseppe Vendramin (Institute of Plant Genetics- Florence, Italian National Council of Research (IGV-FI/CNR) Italy): **FORGER FP7 EU project- a short introduction**

14:10 – 14:40 Csaba Mátyás (University of West Hungary, Inst. of Environmental and Earth Sciences (NymE) Hungary): **Challenges of climate changes for conservation of genetic resources**

14:45 – 15:45 Maria Höhn (Corvinus University Budapest, Department of Botany, Hungary): **Did human mediated processes shape phylogeographic pattern of Carpathian pine populations?**

Coffee break

16:00 – 17:00 Giovanni Giuseppe Vendramin (Institute of Plant Genetics- Florence, Italian National Council of Research (IGV-FI/CNR) Italy): **Dissecting the role of demography and natural selection in shaping population genetic structure in conifers**

17:00 – 17:45 Open Forum: **Research and applied interests of participants, plans & proposal for the future, interaction with speakers. Suggestions for avoiding research gaps and maintaining a constant flux of information and knowledge transfer. Relevance of genetic research for forest management and conservation practices. contd..**

2nd Sep. 2014

9:00 – 13:00 Excursion to Forest Research Institute Sárvár:

Conifer clone collections, Kisunyom

Seed orchard complex of the Szombathely Forestry Corp., Acsád

Vist to Farkas-erdő, from Káld to Bejcgyertyános

Lunch break in the hunting box in Sárvár

14:00 – 14:30 Klára Cseke (Hungarian Forest Research Institute (ERTI)): **Hybridization and recruitment in a mixed stand with 3 different oak species**

14:30 – 15:30 Bruno Fady (French National Institute for Agricultural Research (INRA) Avignon, France): **The genetic composition of marginal populations, the conservation of genetic resources**

Coffee break

15:45 – 16:45 Stephen Cavers (Centre for Ecology and Hydrology (CEH) UK): **Conifer case studies**

16:45 – 17:45 Open forum continued

17:45 – 18:20 Csaba Mátyás (University of West Hungary, Inst. of Environmental and Earth Sciences (NymE) Hungary): **Hungary and Hungarians- some witty anecdotes**

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3rd Sep. 2014

8:45 – 10:45 Konstantin Krutovsky (Georg August University of Göttingen, Dept. of Forest Genetics and Forest Tree Breeding, Germany): **Sequencing and conservation genomics**

Coffee break

11:00 – 12:00 Gunnar Jansson (Skogforsk, Uppsala Science Park, Uppsala, Sweden): **Swedish programme for conifer conservation and breeding**

Lunch break

13:00 – 14:00 Excursion to the Kámoni Arboretum

14:00 – 14:30 Sándor Bordács (National Food Chain Safety Office (NÉBIH), Hungary): **Restoration of rare or endangered species based on examples of black poplar**

14:30 – 15:00 Kurt Ramskogler (LIECO GmbH & Co KG, Austria): **Genetics in a commercial conifer nursery**

15:00 – 15:30 General discussion and distribution of certificates of participation

End

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