Some experiences and results from the Norwegian-Estonian Research Cooperation Programme project:

DNA-based early detection and diagnostics of alien invasive forest pathogens and tracing of their introduction pathways into northern Europe

Rein Drenkhan, PhD

Associate professor of forest pathology

rein.drenkhan@emu.ee

Estonian University of Life Sciences,

Institute of Forestry and Rural Engineering,

Tartu, Estonia

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Content of the presentation

- Some information about my project
- Some practical notes for the project application

My project and why was the project needed?

- Forests in the Baltic and Nordic countries are **increasingly challenged by new forest pathogens**.
- In the recent years, more than 10 new invasive disease agents have already been documented on conifers and deciduous trees in the Baltic and Nordic countries, e.g. Dothistroma needle blight and ash dieback.

My project and why was the project needed?

- **Invasive alien species (IAS) are recognized as one of the largest threats to the world's biodiversity** (e.g. ash dieback in Europe).
- The annual economic losses due to IAS within Europe alone have been estimated annually as 12 billion euros.
- Once an introduced species has established in an area, it is very difficult to eliminate it.
- With growing import of exotic plants, pulpwood and timber products, there is an urgent need to develop diagnostic screening methods.

Dothistroma needle blight is dangerous to exotic conifers, like *Pinus mugo*

Dothistroma needle blight affects also native Scots pine

Ash dieback is reason for massive death of European ash (*Fraxinus excelsior*) all over Europe

Main objectives of the project

Aims of this three-year project (2014-2016), financed by the Norwegian-Estonian Research Cooperation Programme:

1) **develop/implement DNA-based molecular assays for rapid detection of invasive pathogens** associated with seeds, seedlings, wood and timber products that are imported to our countries.
2) establish the **introduction pathways** of two invasive pathogens (*Dothistroma* needle blight of conifers and ash dieback) to Estonia and Norway.
3) explore **the impact of the targeted invasive pathogens on microbial biodiversity**, normally associated with tree foliage.

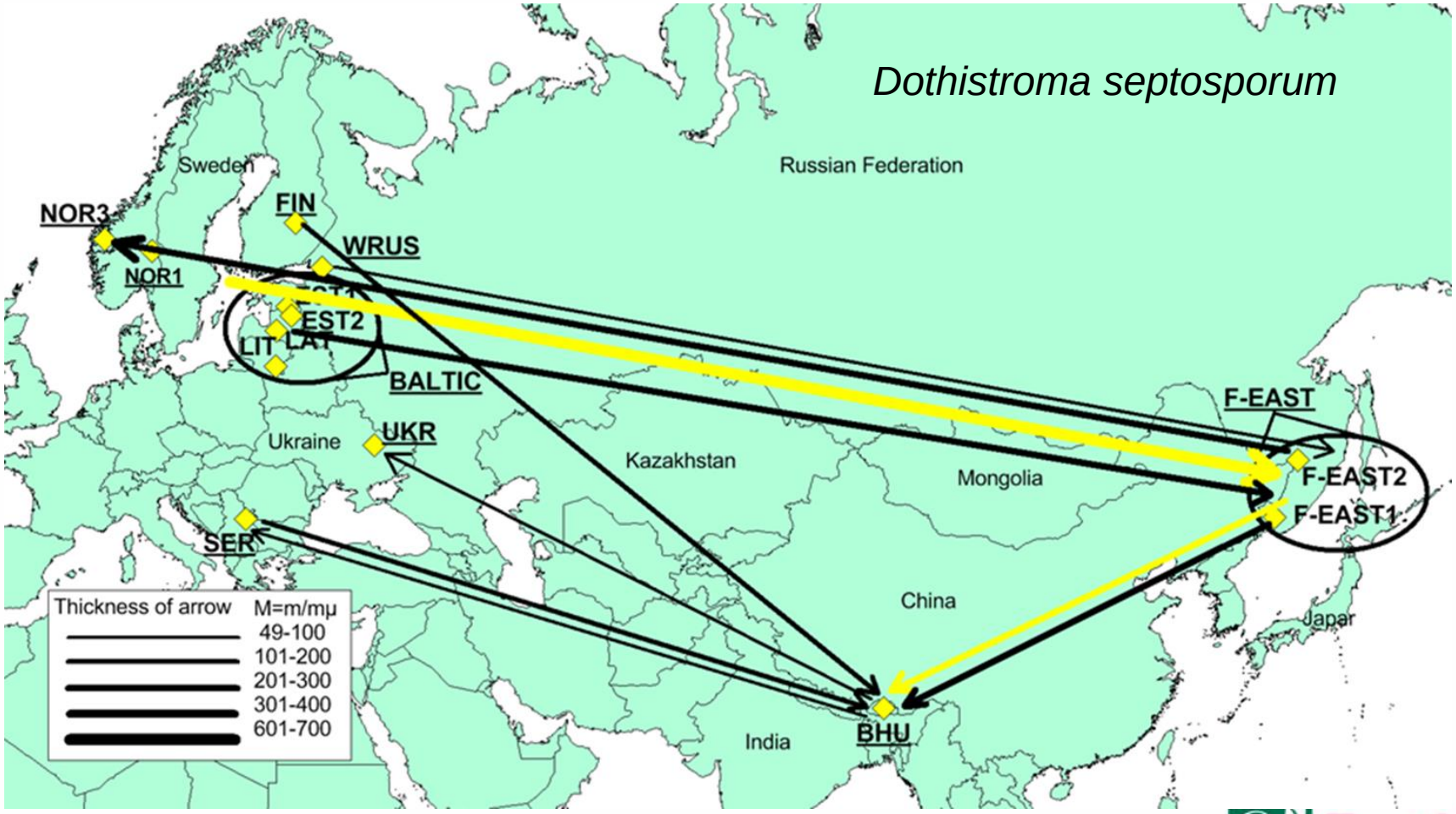
The most important results I

- **One project objective** was to design and implement DNA-based diagnostic methods that allow their early detection.
- 113 imported biological samples (plants and wood) were analysed and **5 % of these samples carried a pathogen that is not native to northern Europe**.
- **This demonstrates the risks of plant trade**, i.e. pathogens may also arrive with plants that are unknown to host a specific pathogen.
- **Eight new DNA primers and probes for detection of invasive pathogens were developed and tested**.

Results II

- A second project objective was **to identify the source populations of two alien pathogens** in Europe.
- We found no support to the hypothesis that **the targeted pathogens in north Europe (*H. fraxineus*; *D. septosporum*) could originate directly from Far East Asia**.
- In contrast, ***D. septosporum* showed surprisingly gene flow of opposite direction**, i.e. from northern Europe to Far East Asia.
- To get the results was wonderful change to visit Russian Far East!

Population genetics and pathway of pathogens

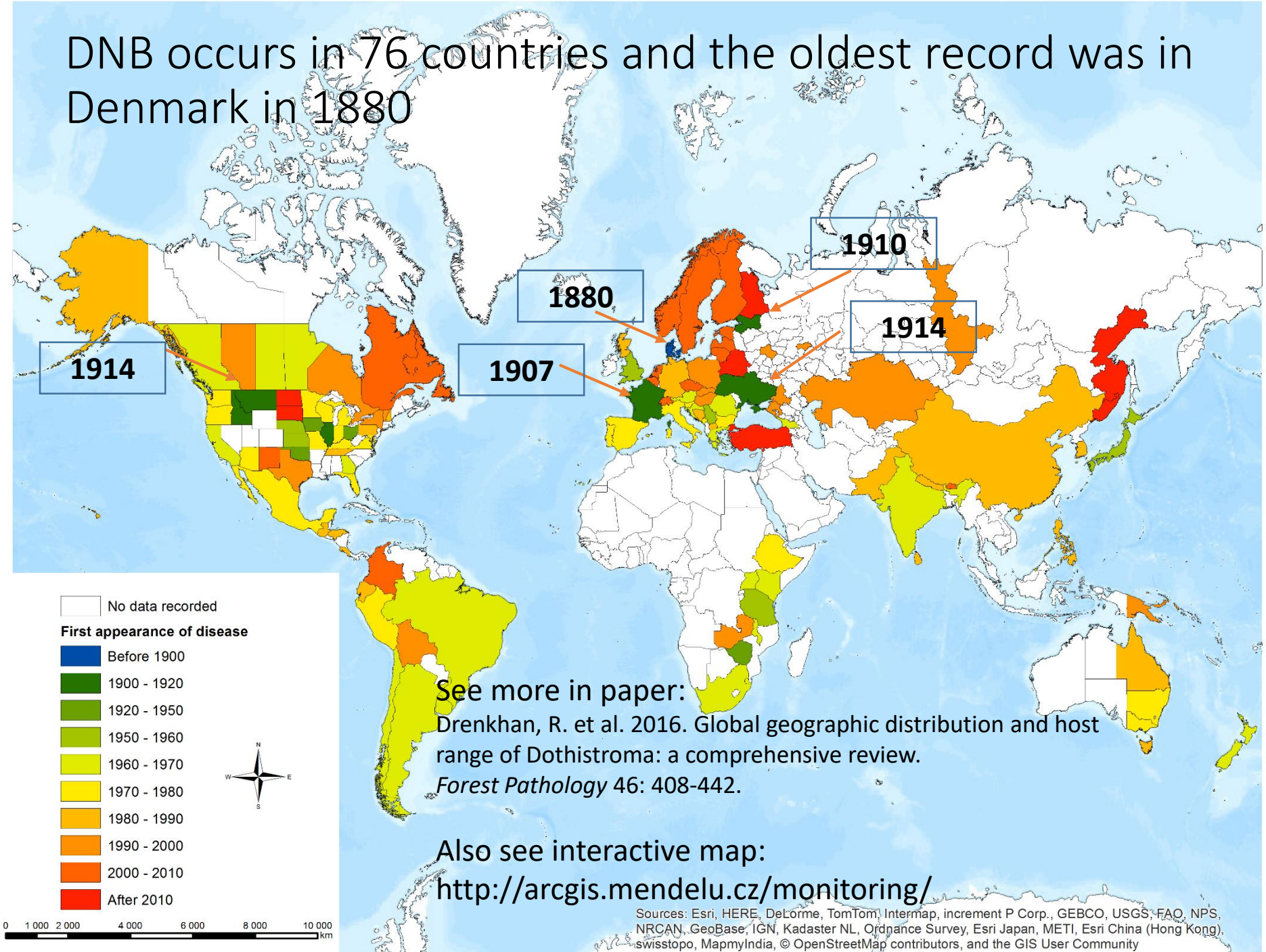


See: Adamson et al. 2018. Fungal Genetics and Biology 110:15–25.

Results III

- Additional results include discovery of new locations for the quarantine pine needle pathogen, *Lecanosticta acicola*, and records of new host species for the ash dieback pathogen *H. fraxineus* and the pine pathogen *Diplodia sapinea*.
- The project also **supported a collaborative work of 66 researchers from 33 countries**: we detailed records of pine disease (Dothistroma needle blight) from **65 countries all over the World and collated them to the international Dothistroma needle blight geo-database** (http://arcgis.mendelu.cz/monitoring/).

DNB occurs in 76 countries and the oldest record was in Denmark in 1880



See more in paper:

Drenkhan, R. et al. 2016. Global geographic distribution and host range of Dothistroma: a comprehensive review. *Forest Pathology* 46: 408-442.

Also see interactive map:

http://arcgis.mendelu.cz/monitoring/

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International cooperation is good base for high level scientific work

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Looking for relationships between the populations of *Dothistroma septosporum* in northern Europe and Asia

Kalev Adamson[a,*], Martin S. Mullett[b], Halvor Solheim[c], Irene Barnes[d], Michael M. Müller[e], Jarkko Hantula[e], Martti Vuorinen[f], Audrius Kačergius[g], Svetlana Markovskaja[h], Dmitry L. Musolin[i], Kateryna Davydenko[j,k], Nenad Keča[l], Karli Ligi[a], Rasa D. Priedite[m], Hanna Millberg[n], Rein Drenkhan[a]

[a] Institute of Forestry and Rural Engineering, Estonian University of Life Sciences, Tartu, Estonia
[b] Forest Research, Alice Holt Lodge, Farnham, Surrey, UK
[c] Norwegian Institute of Bioeconomy Research, Ås, Norway
[d] Department of Genetics, FABI, University of Pretoria, Pretoria, South Africa
[e] Natural Resources Institute Finland (Luke), Helsinki, Finland
[f] Natural Resources Institute Finland (Luke), Suonenjoki, Finland
[g] Vokė Branch of Lithuanian Research Centre for Agriculture and Forestry, Vilnius, Lithuania
[h] Laboratory of Mycology, Nature Research Centre, Vilnius, Lithuania
[i] Saint Petersburg State Forest Technical University, Saint Petersburg, Russia
[j] Department of Biotechnology and Environment, Kharkiv Zooveterinary Academy, Kharkiv, Ukraine
[k] Department Forest Mycology and Plant Pathology, Swedish University of Agriculture Science, Uppsala, Sweden
[l] Faculty of Forestry-University of Belgrade, Belgrade, Serbia
[m] Latvian State Forest Research Institute, Salaspils, Latvia
[n] Department of Forest Mycology and Plant Pathology, Swedish University of Agricultural Sciences, Uppsala, Sweden

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ABSTRACT

Dothistroma septosporum, a notorious pine needle pathogen with an unknown historical geographic origin and poorly known distribution pathways, is nowadays found almost in all areas inhabited by pines (*Pinus* spp.). The main aim of this study was to determine the relationship between North European and East Asian populations. In total, 238 Eurasian *D. septosporum* isolates from 11 countries, including 211 isolates from northern Europe, 16 isolates from Russian Far East and 11 isolates from Bhutan were analysed using 11 species-specific microsatellite and mating type markers. The most diverse populations were found in northern Europe, including the Baltic countries, Finland and European Russia. Notably, *D. septosporum* has not caused heavy damage to *P. sylvestris* in

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Outcome of the project

- The project demonstrates the **risks involved in international plant trade, and emphasises the need for increased political and public awareness** to meet this threat.
- **The results clarifies global spread and practical plant quarantine regulations** for some invasive species!
- The project dissemination: so far **10 scientific papers, 3 of which were joint publications with Norwegian partner**. A total of **26 presentations** to national and international audiences.

The role of the Norwegian partner in the project. Why the partnership was important?

- The **role of the Norwegian partner** is to share valuable knowledge, experience and skills that combine molecular genetics and bio-informatics in plant pathology.
- An explicit **aim of the partnership** is to contribute in the education of excellent young researchers.
- The **good results of the cooperation project** made the participant groups attractive partners for future national and international applications.

Project participants

- **Project Promoter, Estonian University of Life Sciences, Institute of Forestry and Rural Engineering.**
- **Dr. Rein Drenkhan,** project leader,
- **Dr. Märt Hanso,** senior scientist,
- **Dr. Kalev Adamson,** PhD student,
- **Dr. Tiia Drenkhan,** PhD student,
- **Mrs. Katrin Jürimaa,** laboratory assistant,
- **Tiit Maaten, Martin Tee, Taavi Riit and others** PhD and master students**.**

- **Donor project partner, Norwegian Institute of Bioeconomy Research**
- **Dr. Ari Hietala,** leader of Norwegian group,
- **Dr. Halvor Solheim,** professor of Forest pathology,
- **Dr. Adam Vivian-Smith,** molecular biologist,
- **Dr. Hugh Cross ,** molecular biologist,
- **Mrs. Inger Heldal**, an engineer.

Project homepage: http://mi.emu.ee/struktuur/metsakasvatuse-ja-metsaokoloogia-oppetool/teadusprojektid/mimk-projektid/project-emp-162/

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The most important for successful application!

- Excellent plan for application.
- To find excellent project partner, which means that the partner is interested in your WONDERFUL plan.
- To write excellent application with project partner.
- To discuss precisely all details in project plan with project partner.
- To submit the application on the right time.
- Good luck! It means that your application is hopefully evaluated by „FRIENDLY“ referees.
- Then you may see good news!

Some practical notes for the cooperation project application

- How to find good project partner?
- How to find same interest for project application?

Not easy, but possible.

Previous contacts have been helped me very much through the Baltic-Nordic Forest Pathology networks and COST (European Cooperation in Science and Technology) networks in forest pathology.

Some practical notes for the cooperation project application

- The project application **should be new and innovative**, not only for you but for referees also!
- The project **plan should be realistic and understandable** for reader as well as both Project partners.
- Realistic project plan = realistic budget!

Some notes from previous Norwegian-Estonian Research Cooperation Programme

- Normal level bureaucracy.
- Simple reporting.
- Quite fast feedback.

You should be ready for higher public and media attention!

Thank you!

Pleomassaria siparia anamorph *Prosthemium betulinum* conidia

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