

Annual report for SNS NordForNet

Submit the annual report to sns@slu.se by 24:00 CET, 1st of March at the latest.
The report should not exceed 2000 words (including words in the template).

Please adjust the box size according to the length of your answer.

1. Project title:	Preventing the spread of new pathogens in Nordic forests to secure sustainable forestry in growing economy
2. Reporting year:	2021

3. Project coordinator:	Johanna Witzell
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Activity report

<p>4. Project status</p> <p>a) Does the project develop according to the plan?</p> <p>b) Describe the activities during the reporting year</p> <p>c) List the delivered key figures for the reporting year (e.g. number of meetings, seminars, conferences, publications, policy briefs etc.)</p>
<p>a) The project is delayed. Because of Covid there have been delays in laboratory analyses due to lockdowns and restrictions to work efficiently in the lab, and some of us have experienced delays also in deliveries from the sequencing services. For the coordinator, extra delays have been unfortunately due to the change of work situation. However, we have met most of the goals despite the challenges and delays.</p> <p>b) In May 2019, the kick-off meeting was held in Sweden. The meeting agenda is attached. Participants presented a brief situation report from their countries. An excursion was organized in collaboration with Sydsvenska Rhododendron- och Magnolia-sällskapet. The meeting agreed on starting the activities according to the work plan. The activities since the kick-off:</p> <p>In Norway, the partners focused on garden soil and garden waste as a pathway for <i>Phytophthora</i>. For the garden soil, a total of 27 potting-mix-soil-bags (different varieties of soil, peat, compost mixtures) that can be bought at garden centres were tested by baiting with Rhododendron leaves and isolating on <i>Phytophthora</i> selective media (PARPH). In addition, eight soil samples from a soil deponi (i.e. soil from various road- and other construction projects) with a soil recycling plant (where the soil is sorted and sold as bulk) was tested. No <i>Phytophthora</i> could be detected from the potting mix soil bags or from the finished product at the soil recycling plant, but <i>P. lacustris</i> was found in a pond and <i>P. megasperma</i> and <i>P. mississippiiae</i> was found in a ditch, both at the centre of the soil deponi/soil recycling plant.</p> <p>For the garden waste, a survey was carried out at the location where Oslo municipality recycle all of Oslo's garden waste. The whole chain of process, from incoming plant material (i.e. garden waste, potted plants, soil, large trees etc.) to different stages of composted soil masses (composting temperatures up to 80 degrees), to the finished products, were sampled (soil samples) and tested for <i>Phytophthora</i>.</p> <p><i>Phytophthora cinnamomi</i> was detected in the incoming plant material and <i>Phytophthora</i> taxon raspberry and <i>Phytophthora cryptogea</i> (species complex) were detected in a ditch inside the facility. However, the finished composted products (sold in bulk or in potting-mix-soil-bags in garden centres) were all free from <i>Phytophthora</i>.</p> <p>In addition to garden soil and garden waste, several diseased plants received at the Plant clinic at NIBIO</p>

have been tested, for *Phytophthora* e.g. *Rhododendron*, *Viburnum*, *Heuchera* from a nursery, sequencing results are pending. A report will be available in 2022, where SNS is mentioned as the source of financing.

In Estonia, the partners collected imported and local sensitive samples from private nurseries. In total, 325 samples were collected: 73 soil samples from container seedlings, 54 shoot, 144 needle, 34 leaf samples from different tree species and 20 wood samples. Finally, 209 samples were sequenced using PacBio and preliminary analyses show presence of pathogenic oomycetes including *Phytophthora*. Additionally, *Phytophthora ramorum* was detected in the leaves of imported *Rhododendron* plant. The partners have also using *Phytophthora* quick tests to monitor symptomatic trees (*Alnus incana* and *A. glutinosa*) in whole Estonia. In total, 36 sites and 360 trees were monitored. The results of quick test monitoring of *Phytophthora* species symptoms on alder species is presented on map, see: https://www.google.com/maps/d/u/0/edit?mid=1twF6GVOB8zM_UhFZHCsyJHXqh21so9Pu&usp=sharing (red positive, green negative).

In Sweden, a new collaboration was initiated with partners from National Property Board Sweden to investigate presence of *Phytophthora* in soil under declining oaks recently planted as alley trees. Baitings resulted in several *Phytophthora* isolates, mainly *P. plurivora*. The collaboration is continued in 2022, to further examine if the contamination might have been derived from the planted trees (i.e. from nursery), planting soil, irrigation water (from the lake nearby), or if it was already present in the soil before the planting took place. Studies have also been continued with a private forest owner to examine the involvement of *Phytophthora* in oak mortality. In this forest, *P. plurivora* and *P. gonapodyides* were captured by baitings. Twenty samples have been sent to total microbiome analyses as a part of a Swedish-Spanish- Czechian collaboration, the results are pending.

In Denmark, activities included continuing monitoring and testing for *Phytophthora* in forests and urban settings, as a part of advisory work for Landbrugsstyrelsen (Danish Plant Health Authority). In addition a new study "Detection of *Sirococcus tsugae* on *Cedrus atlantica* in Denmark" was undertaken in collaboration with Ana Perez-Sierra (UK)(network collaborators Iben M. Thomsen, Venche Talgø) from which first report publication is pending.

In Finland, the accumulation of fungal populations and oomycetes in birch and spruce trees after vole or mechanical damage were studied. The samples from long-term field and forest experiments were collected and subjected to NGS analysis. The results are being analyzed. The other partners have contributed to the project goals by producing information material and reviews, collecting samples for the soil analyses, and guiding students.

With these results, we can consider hypothesis 2 (*Phytophthora* species capable of infecting forest trees are common in soil samples) partly confirmed. However, it should be noted that in Norway *Phytophthoras* were not detected in soil bags, whereas a study carried out in Sweden revealed that *Phytophthora cambivora* was present across all habitats and in commercial soils. Appearance of *P. cinnamomi* in commercially available plants as shown in Norway and Sweden, and that of *P. ramorum* (Estonia) is alarming.

The network has also worked on a joint review paper "Current possibilities and challenges in technologies for early detection of forest pests". The Introduction and Material and Methods sections are drafted, and a collection of 179 publications is waiting for the analysis.

- c) Because of the pandemic we have not had joint meetings in 2020 and 2021. The relevant publications with input from the network members are listed under 5.

5. List the published outputs during the reporting year (peer-reviewed articles, other publications):

Peer-reviewed articles with significant input from network members:

- 1) Cleary M et al. (2021) Oomycetes in rhizosphere soil of ornamental plants from retail nurseries in Southern Sweden. *Forest Pathology*, 51:e12673

- 2) Pötzelsberger E et al. (2021) Biotic threats for 23 major non-native tree species in Europe. *Scientific Data* 8:1-8
- 3) Hamberg L et al. (2021) Root discoloration and shoot symptoms in silver birch after *Phytophthora* infection in vitro. *Plant Biology* (Stuttg.) 23:162-171.
- 4) Benavent C et al. (2021) Current practices and emerging possibilities for reducing the spread of oomycete pathogens in terrestrial and aquatic production systems in the European Union. *Fungal Biology Reviews*, in press.
- 5) Romeralo C et al. (2022) Pine species determine fungal microbiome composition in a common garden experiment. *Fungal Ecology* 56, 101137.
- 6) Rossmann, S., Lysøe, E., Skogen, M., Talgø, V., & Brurberg, M. B. (2021). DNA metabarcoding reveals broad presence of plant pathogenic oomycetes in soil from internationally traded plants. *Frontiers in microbiology*, 12, 645.

Other published outputs with relevance to the project

- 1) Talgø, V., Pettersson, M., Perminow, J. I. S., Magnusson, C., Blystad, D. R., & Brurberg, M. B. (2019). Norsk natur trues av fremmede plantesjukdommer. *Naturen*, 143(6), 287-296.
- 2) Pettersson, M., Brurberg, M. B. & Talgø, V. 2020a. Kartlegging av *Phytophthora* langs Lommedalselva 2020. *NIBIO Rapport* 6(154), 1-15. <https://hdl.handle.net/11250/2719395>
- 3) Pettersson, M., Brurberg, M. B. & Talgø, V. 2020b. Kartlegging av *Phytophthora* langs Makrellbekken 2020. *NIBIO Rapport* 6(155), 1-17. <https://hdl.handle.net/11250/2719392>
- 4) Pettersson, M., Brurberg, M. B. & Talgø, V. 2020c. *Phytophthora*. Delrapport for 2019 i OK-programmet «Nematoder og *Phytophthora* spp. i jord på importerte planter». *NIBIO Rapport* 6(39), 1-22. <https://hdl.handle.net/11250/2657510>
- 5) Pettersson, M., Brurberg, M. B. & Talgø, V. 2021a. Kartlegging av *Phytophthora* langs Akerselva ved Bjølsen 2021. *NIBIO Rapport* 7(197), 1-19. <https://hdl.handle.net/11250/2833469>
- 6) Pettersson, M., Brurberg, M. B. & Talgø, V. 2021b. Kartlegging av *Phytophthora* langs E6 mellom Værnes og Ranheim 2021. *NIBIO Rapport* 7(169), 1-25. <https://hdl.handle.net/11250/2828330>
- 7) Pettersson, M., Brurberg, M. B. & Talgø, V. 2021c. Kartlegging av *Phytophthora* langs vassdrag i Oslo 2021. *NIBIO Rapport* 7(207), 1-43. <https://hdl.handle.net/11250/2836110>
- 8) Pettersson, M., Brurberg, M. B. & Talgø, V. 2021d. Omfattende kartlegging av *Phytophthora* i Bymiljøetatens planteskole, Oslo Bytrær, i Sørkedalen 2021. *NIBIO Rapport* 7(170), 1-21. <https://hdl.handle.net/11250/2833475>
- 9) Talgø, V., Brurberg, M. B. & Pettersson, M. 2021. *Phytophthora*-analyse av snø produsert på vann fra Sørkedalselva. *NIBIO rapport* 7(71), 1-13 <https://hdl.handle.net/11250/2737058>
- 10) Talgø, V., Brurberg, M. B. & Pettersson, M. 2020a. Kartlegging av *Phytophthora* i Bymiljøetatens planteskole i Oslo 2019. *NIBIO Rapport* 6(106), 1-14. <https://hdl.handle.net/11250/2669984>
- 11) Talgø, V., Brurberg, M. B. & Pettersson, M. 2020b. Kartlegging av *Phytophthora* langs Sørkedalsvassdraget 2019. *NIBIO Rapport* 6(37), 1-19. <http://hdl.handle.net/11250/2645586>
- 12) Talgø, V., Perminow, J. I. S., Pettersson, M. & Brurberg, M. B. 2019b. Sjukdomar på tre i Oslo. *NIBIO Rapport* 5(78), 1-25. <https://hdl.handle.net/11250/2647308>
- 13) Talgø, V. & Pettersson, M. 2020. *Phytophthora* i Sørkedalen - råd og tiltak for landbruksnæringen. *NIBIO Rapport* 6(180), 1-17. <https://hdl.handle.net/11250/2721835>
- 14) Talgø, V., Brurberg, M. B. & Pettersson, M. 2020b. Undersøkelse for *Phytophthora* i settefiskanlegg i Sørkedalen Rapport 7(10), 1-13. <https://hdl.handle.net/11250/2725552>
- 15) Talgø, V., Pettersson, M. & Brurberg, M. B. 2019c. *Phytophthora*. Delrapport for 2018 i OK-programmet «Nematoder og *Phytophthora* spp. i jord på importerte planter». *NIBIO Rapport* 5(62), 1-24. <https://hdl.handle.net/11250/2712047>
- 16) Bekeris E (2020) Diversity of fungi colonizing the leaves of common ash (*Fraxinus excelsior* L.) of different health status. MSc thesis (supervisor Marčiulyrienė D).
- 17) Čėsna V (2020) Influence of *Lymantria monacha* outbreaks on the diversity of non-target insect communities and microorganisms in Scots pine stands. PhD thesis. (supervisor Marčiulyrienė D)
- 18) Jarašiūtė A (2020) Study of the causal agent of ash dieback *Hymenoscyphus fraxineus* properties and search for antagonistic microorganisms BSc thesis. Mizerienė (Norkutė) G (superv.)
- 19) Pershagen K. (2021). Health and vitality of sycamore maple (*Acer platanoides*) in Southern Sweden. SLU Alnarp (supervisor J. Witzell)

- 20) Poimala, A. (2019) Species information cards in: Finnish Biodiversity Information Facility; *Phytophthora plurivora*. <https://laji.fi/taxon/MX.52947>
- 21) Poimala, A. (2019) Species information cards in: Finnish Biodiversity Information Facility; *Phytophthora alni*. <https://laji.fi/taxon/MX.5077010>
- 22) Schmidt C (2020) Occurrence of Phytophthora species in soils, and functional analysis of soil microbiomes on Biolog EcoPlates - A study on commercial soils, and forest and urban soils. MSc thesis. SLU Alnarp (supervisor J. Witzell)
- 23) Thomsen IM, Talgø V (2020) IPM forebyggelse af Phytophthora i skove. Information leaflet, partly financed by Miljøstyrelsen in Denmark
- 24) Uimari A, Poteri M, Vuorinen M (2019) Neonectria diseases in conifers / Neonectria-sienitaudit havupuilla: Kuusen mustakoro ja pihdan korotauti. Report in: Forest Damage in 2018 / Metsätuhot vuonna 2018. Luonnonvara- ja biotalouden tutkimus 85/2019: 35-37. (in Finnish)
- 25) Witzell J, Cleary M (2019) *Phytophthora*-damage in deciduous forests of Southern Sweden - from genes to landscape. XXV IUFRO World Conference, Curitiba, Sept 29-Oct 5, 2019. (oral presentation of an e-poster).
- 26) The Estonian group has produced a map showing the results of quick test monitoring of *Phytophthora* species symptoms (red positive, green negative) on alder species in Estonia: https://www.google.com/maps/d/u/0/edit?mid=1twF6GVOB8zM_UhFZHCsyJHXqh21so9Pu&usp=sharing

6. List other practical outputs during the reporting year (websites, policy recommendations, conferences, scientific meetings, large-scale project applications, research training etc.)

Oral communications:

- 1) In Norway, the partners have given talks where the recycling of garden waste has been mentioned – see selected slides attached.
- 2) Lygis V., Piūra A., Burokienė D., Bakys R., Gustienė A., Marčiulytė D., Suchockas V. (2019) Ash dieback in Lithuania: entering a third decade of the hard battle. Oral presentation at „Consolidating approaches to mitigate the ash dieback disease in the Baltic States and Germany“ workshop (Vilnius, Nature Research Centre)/conference (Girionys, Kaunas distr., KMAIK) [Lithuania], October 16-17, 2019
- 3) Uimari A (2019) Effects of climate change on forest pests in tree seedling production. Oral presentation at the Forest tree seedling annual meeting, Finland, January 15-16, 2019
- 4) Uimari A (2019) Invasive pests and diseases on natural forests in Finland. Oral presentation at the NordGen Forest Workshop, Iceland, September 16, 2019
- 5) Uimari A (2019) The role of climate factors in association with spread of invasive forest pests with special focus on plant production Oral presentation at NordGen Forest Conference, Iceland, September 17-18, 2019
- 6) Thomsen IM (2019) Spredning af sygdomme og skadedyr - hvordan kan I være med til at forhindre det? Two oral presentation about the risk of invasive species held twice at Have&Landskab (HL19), for an audience of green space managers (including municipalities) and contractors (gardeners etc)
- 7) Thomsen IM (2021) Skadevoldersituationen 2021. Oral presentation about new pests and diseases at Bytræseminariet 2021, a yearly conference at University of Copenhagen for urban space managers and companies Presentation together with Lis T. Stenstrup from Landbrugsstyrelsen (Danish Plant Health Authority).
- 8) Witzell J (2019) Aftermath of tree diseases - new solutions for regeneration of declined stands. Oral Presentation at SNS Forest Regeneration network meeting, Tallinn, November 5-6, 2019

Teaching:

In Sweden, the network partners have informed about the project and its findings in MSc course (<https://www.slu.se/en/education/programmes-courses/course/SG0271/10092.2122/Diagnosis-prevention-and-management-of-biotic-forest-damage/>) for students at SLU and LNU (2021). Consequently, two 2 new MSc thesis projects, related to the new pests and pathogens have been initiated at LNU.

Larger project applications:

Connected to the networks goals, a COST Action proposal “Urban Tree Guard – Safeguarding European urban trees and forests through improved biosecurity” was prepared. The proposal was supported by network members who

will also continue as participants, with two network members in leadership roles (Witzell, Marciulyniene). The www.cost.eu/actions/CA20132 proposal will focus on urban settings as pathways.

Dissemination material:

Poster and infographic – See *attachments*

7. Provide an updated activity plan, stating the planned activities for the coming year (March-March)

We would like to ask for a prolongation of the project and final financing period until end of 2022. During this period we plan to:

- 1) Finalize the joint efforts in analysis of soil samples and compile data for a jointly prepared synthesis (Hypothesis 2) – appr. 230 000 kr
- 2) Finalize the review "Current possibilities and challenges in technologies for early detection of forest pests" that has been started (Hypothesis 1) – salaries app. 180 000 kr + 2 day meeting about 60 kSEK
- 3) organize the planned focus group discussion with stakeholder representatives – appr. 45 000 SEK

Economic report

8. Received grant from SNS for the reporting year (SEK):

According to proposal: 2019 - 335 000; 2020 - 335 000

9. Transfer of SNS funds to project partners

Country	Partner/organisation	Sum (SEK)
Denmark	KU	87100
Finland	LUKE	117250
Sweden	SLU	193129
Norway	NIBIO	114730
Iceland	-	
Other countries (specify)	EMU (Estonia), Lithuanian Research Centre for Agriculture and Forestry and Nature Research Centre (Lithuania)	117308 (EE)+39757 (LT)
Total SUM		670000

10. Costs

in SEK	SNS funding	Co-financing		Total
		Cash	In-kind	
Travel and accommodation	44 076			44 076
Meeting costs	7 330	1 800		9 130
Communication	823	295		1 118
Salary and OH	332 305		689 696	1 022 001
Other costs (specify) Consumables Sequencing costs	117 233		183 831	301064

Chemicals				
Bench fees				
Open Access				
Total SUM (SEK)	5 0 1 7 6 7	2 0 9 5	8 7 3 5 2 7	1 3 7 7 3 8 9

Optional: Comments to the economic overview:

9. Transfer - Small adjustments in transfer are still to be done to the year 1 and 2 budget (LT needs to request 7143 SEK, NO 2520 SEK of their shares).

10. **The project has a surplus of 168233SEK.**

I hereby declare that the above statements are true to the best of my knowledge

Signature of the main applicant/project coordinator		
------(e-sign)-----	SLU	2022-03-07
Signature	Organisation	Date
Johanna Witzell		

Printed name		

Signature of the head at the department of the main applicant		
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Signature	Organisation	Date

Printed name		

Second applicant's signature, place and date		
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Signature	Organisation	Date

Printed name		

Third applicant's signature, place and date



Københavns Universitet

21-2-2022

Signature

Organisation

Date

Iben M. Thomsen

Printed name

Fourth applicant's signature, place and date

Signature

Organisation

Date

Printed name

Fifth applicant's signature, place and date



NIBIO

21/02-2021

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Organisation

Date

Martin Pettersson

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