

Report for EFINORD-SNS Networks

Submit the report to sns@slu.se and efinord@efi.int by 24:00 CET, 1st of March the year after the activities. The report should not exceed 1500 words (including words in the template).

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

1. Network title:	NEFOM – North European Forest Mycologists
2. Network number:	N2018-05

3. Network coordinator:	Karina Engelbrecht Clemmensen
Email:	Karina.clemmensen@slu.se
Address:	BioCenter, Forest Mycology & Plant Pathology PO Box 7026 SE-750 07 Uppsala Sweden

Activities during the reporting year:

4. Place of the activity:	Uppsala
Duration of the activity (start date, end date):	2018/01/01 – 2018/12/31

5. Provide a short network summary, including:

- a) A background to the network
- b) The main activities of the network

Network background:

The long-term aim of the network is to strengthen the collaboration between the NEFOM labs all working with (molecular) identification and ecology of forest fungi. We build and share research-based knowledge about the diversity, function, and applied aspects of fungi in forests, and stimulate networking among younger participants (PhD students and post docs). Our activities involve planning and executing scientific meetings and up-to-date PhD courses and exchanging students between labs to facilitate knowledge transfer. Another key element is the maintenance and development of public sequence databases and bioinformatics tools. We also use the network as a platform for research grant proposals.

Main activities during 2018:

- 21-23. March 2018, Copenhagen: **database workshop**; planning of adding the current 800,000 fungal sequences in UNITE to the GBIF index and discussions on the next steps needed for integration of the currently published data from individual next generation sequencing projects to UNITE and GBIF for improved utilization for biogeographical studies of fungi.
- 22-26. September 2018: **NEFOM annual meeting**: Climate change effects on fungi and their activities. Oulanka Research Station, Finland. Participants: 20 network participants (13 phd students or postdocs), 2 invited guest lecturers (Prof. Lynne Boddy, Cardiff University & Petr Kohout, Czech Academy of Sciences). We visited various typical forest ecosystems in the area to collect fungal specimens, and discussed 16 scientific presentations and had a tour of the field station facilities and presentations of ongoing research and monitoring activities by personnel at the station.

- 13-16. January 2019: **PhD course/workshop**: Identification and publishing HTS/Sanger DNA sequence datasets. Copenhagen. Participants: 11 NEFOM PhD students and postdocs, 9 other participants, 4 NEFOM teachers, 2 GBIF teachers. Arranged in cooperation with Global Biodiversity Information Facility (GBIF) Copenhagen. NEFOM supported student travels and accommodation.
- The sequence database **UNITE** (<http://unite.ut.ee/>) as well as the bioinformatics tools **SCATA** (<http://scata.mykopat.slu.se/>), **PLUTOF** (<http://plutof.ut.ee/>) and **CLOTU** (<http://www.bioportal.uio.no/>), all hosted by network participants, have been continued to be maintained and developed.
- The **NEFOM homepage** has been maintained: <http://www.nefom.dk/>

6. List the outputs of the network (peer-reviewed articles, other publications, websites, policy recommendations, conferences, scientific meetings, large-scale project applications, research training etc.)

The network had a combined output of about over 50 peer-reviewed papers during 2018. Here is a selection of papers representing the focus areas of 2018 and in which several NEFOM members were involved.

DNA-based classification of fungi:

Tedersoo, L., S. Sanchez-Ramirez, **U. Koljalg**, **M. Bahram**, M. Doring, **D. Schigel**, T. May, M. Ryberg and **K. Abarenkov** (2018). "High-level classification of the Fungi and a tool for evolutionary ecological analyses." *Fungal Diversity* **90**(1): 135-159.

Thomson, S. A., ..., **T. Frosvlev**, ..., **U. Koljalg**, ..., **D. S. Schigel**..., Z. Q. Zhang and H. Z. Zhou (2018). "Taxonomy based on science is necessary for global conservation." *Plos Biology* **16**(3).

Ryberg, M. and **R. H. Nilsson** (2018). "New light on names and naming of dark taxa." *Mycokeys*(30): 31-39.

Anslan, S., **R. H. Nilsson**, C. Wurzbacher, P. Baldrian, **L. Tedersoo** and **M. Bahram** (2018). "Great differences in performance and outcome of high-throughput sequencing data analysis platforms for fungal metabarcoding." *Mycokeys*(39): 29-40.

Abarenkov, K., P. Somervuo, **R. H. Nilsson**, P. M. Kirk, T. Huotari, N. Abrego and **O. Ovaskainen** (2018). "Protax-fungi: a web-based tool for probabilistic taxonomic placement of fungal internal transcribed spacer sequences." *New Phytologist* **220**(2): 517-525.

Fungal biogeography:

Andrew, C., ..., **J. Heilmann-Clausen**, ..., L. Boddy, U. Buentgen and **H. Kausserud** (2018). "Continental-scale macrofungal assemblage patterns correlate with climate, soil carbon and nitrogen deposition." *Journal of Biogeography* **45**(8): 1942-1953.

Andrew, C., ..., **J. Heilmann-Clausen**, A. C. Gange, S. Egli, C. Bassler, U. Buntgen, L. Boddy and **H. Kausserud** (2018). "Explaining European fungal fruiting phenology with climate variability." *Ecology* **99**(6): 1306-1315.

Norden, J., J. Astrom, T. Josefsson, S. Blumentrath, **O. Ovaskainen**, A. Sverdrup-Thygeson and B. Norden (2018). "At which spatial and temporal scales can fungi indicate habitat connectivity?" *Ecological Indicators* **91**: 138-148.

Fungal ecology:

Sterkenburg, E., **K. E. Clemmensen**, A. Ekblad, R. D. Finlay and **B. D. Lindahl** (2018). "Contrasting effects of ectomycorrhizal fungi on early and late stage decomposition in a boreal forest." *Isme Journal* **12**(9): 2187-2197.

van der Plas, F., S. Ratcliffe, ..., **D. Nguyen**, ..., F. Roger, ..., **J. Stenlid**, ..., L. Gamfeldt and E. Allan (2018). "Continental mapping of forest ecosystem functions reveals a high but unrealised potential for forest multifunctionality." *Ecology Letters* **21**(1): 31-42.

Castano, C., **B. D. Lindahl**, J. G. Alday, **A. Hagenbo**, J. M. de Aragon, J. Parlade, J. Pera and J. A. Bonet (2018). "Soil microclimate changes affect soil fungal communities in a Mediterranean pine forest." *New Phytologist* **220**(4): 1211-1221.

Redondo, M. A., J. Boberg, **J. Stenlid** and J. Oliva (2018). "Functional traits associated with the establishment of introduced *Phytophthora* spp. in Swedish forests." *Journal of Applied Ecology* **55**(3): 1538-1552.

Hagenbo, A., **J. Kyaschenko**, **K. E. Clemmensen**, **B. D. Lindahl** and P. Fransson (2018). "Fungal community shifts underpin declining mycelial production and turnover across a *Pinus sylvestris* chronosequence." *Journal of Ecology* **106**(2): 490-501.

Lopez-Garcia, A., M. Gil-Martinez, C. M. Navarro-Fernandez, **R. Kjoller**, C. Azcon-Aguilar, M. T. Dominguez and T. Maranon (2018). "Functional diversity of ectomycorrhizal fungal communities is reduced by trace element contamination." *Soil Biology & Biochemistry* **121**: 202-211.

7. How and within which areas was the network beneficial for the Nordic countries?

Nordic forests and forestry has much in common with more southern forests, but they also possess characteristics that are specific to Northern conditions, such as short growing season, low temperatures, nitrogen limited primary production and low organic matter decomposition rates. Fungi are particularly important for decomposition processes and nutrient transfer to the trees and as tree pathogens, and particular fungal communities are associated with Northern forests. Therefore, research cooperation aimed at understanding the drivers of fungal diversity and community composition as well as understanding how different fungi affect forest processes and production is highly needed.

All members in the NEFOM network depend on molecular techniques in our research. The extent to which DNA- and RNA-based data are useful for inferring species-level autecology, biogeographical patterns and functional properties of fungal communities depend completely on the extent to which we are able to define, name and characterize 'molecular species' in a consistent and comparable way. Therefore, continued development of these techniques in a cooperative manner across research labs is crucial. Only regional coordination will allow building up databases containing consistent and comparable data, both of species occurrences across different systems and of their taxonomic and functional metadata. The NEFOM network is evolved around the group of researcher who initially started the UNITE database on fungal DNA sequences focusing on Nordic systems and continues to strengthen the collaboration between leading Northern European mycology research groups.

With the current, fast development of molecular tools - both in lab and in silico - researchers and students are exposed to many choices, and by keeping PhD courses up-to-date via intellectual and financial support from this network, we educate internationally competitive new researchers within the field. The network provides an excellent platform for emerging young researches at the PhD and post doc level to integrate within the strong Nordic research environment.

8. Provide a short popular science piece of the project (maximum 500 characters) for publication by SNS in various channels

During 2018, the NEFOM research network arranged several successful meetings and courses where researchers and students discussed ongoing projects and technical developments. Several new studies suggested strong climatic effects on fungi, and other studies highlighted important functional differences among fungal species. Together these findings underpin the importance of furthering our understanding of how climatic changes may affect fungal provisioning of important functions in Northern forests, such as tree nutrient delivery and carbon sequestration. An important technical line of 2018 activities has been to integrate DNA-based fungal data into the Global Biodiversity Information Facility (GBIF) database. In the publicly available GBIF, it is easy to visualize geographical distributions of fungi, now also based on knowledge achieved by DNA sequencing of soil fungi often living secret lives below-ground!

Participation

9. Number of participants

Country	Young researchers / PhD students	Senior researchers	Stakeholders	Others (specify)	Gender			Total
					Women	Men	Other	
Denmark	3	5			2	6		8
Finland	5	5			3	7		10

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Iceland		2			1	1		2
Norway	10	5			8	7		15
Sweden	11	9			10	10		20
Estonia	5	5			5	5		10
Latvia	1				1			1
Lithuania		1			1			1
Scotland	1	1			1	1		2
...								
...								
Total	36	33			32	37		69

Economic report

10. Received grant from SNS and EFINORD (SEK):
203.000

11. Transfer of SNS funds to network partners

Country	Partner organization	Sum (SEK)
Denmark		
Finland		
Sweden	The full amount was administered through the coordinator's home institution at SLU	203.000
Norway		
Iceland		
Other countries (specify)		
Total SUM		203.000

12. Costs

	SNS funding	External funds	Total
Travel and hotel	153.557	35.000	188.557
Meeting costs	43.137	25.000	68.137
Salary	Not allowed	160.000	160.000
Communication	0	0	0
Other costs (specify)	0	0	0
Total SUM (SEK)	196.693	220.000	416.693

Optional: Comments to the economic overview:

Co-funding of 5000 EURO was provided by GBIF-Copenhagen for the PhD course/workshop in January 2019. Other co-funding was in-kind funding of salaries and travel costs.

Note to Salary: A major external fund for the network is the lecturing and preparation time in PhD courses. This amount is difficult to calculate as it depends on salaries and overheads by participating lecturers. The amount included here is most probably an underestimate. The time spend on network management and meeting planning is also funded by in-kind contribution by network participants and economy administrators.

The 6.307 SEK left from the 2018 funding we would like to allocate to travel support in conjunction with a small meeting during 2019 to plan the future of our network.

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

Main applicant's signature, place and date



Karina Clemmensen..... Forest Mycology & Plant Pathology..... 28/02/2019.....
(Signature) (Institution) (Day / Month / Year)

Signature of the head of the main applicant's research institution



..... Forest Mycology & Plant Pathology.... 28/02/2019.....
(Signature) (Institution) (Day / Month / Year)

Sara Hallin, Head of Department.....
(Printed name, function)

Second applicant's signature, place and date



Rasmus Kjøller..... University of Copenhagen..... 28/02/2019.....
(Signature) (Institution) (Day / Month / Year)

Third applicant's signature, place and date



Urmas Kõljalg.....
(Signature)

Tartu University.....
(Institution)

..... 28/02/2019.....
(Day / Month / Year)