# Report for annual networks

Submit the report to sns@slu.se by 24:00 CET, 1st of March the year after the network period.
The report should not exceed 2000 words.

**Please adjust the size of the boxes to the length of your answer.**

| | |
|---|---|
| 1. Title of the network: | North European Forest Ungulate Network (NEFUN) |
| 2. Network number: | N2021-01 |

| | |
|---|---|
| 3. Main applicant: | Annika M. Felton |
| Email: | Annika.felton@slu.se |
| Address: | Southern Swedish Forest Research Center, SLU<br>Box 190, 234 22 Lomma |

## Activities

| | |
|---|---|
| 4. Place of the activities: | Abisko Research Station |
| Duration of the activities (start date, end date): | 27-29 May 2022 |

5. Provide a short network summary, including:

a) The purpose of the network/main problems/background

Large wild herbivores, such as ungulates, can be major drivers of the biodiversity, processes and services of forest ecosystems. The ungulates can influence vegetation composition, nutrient recycling, habitat structure and thus also microclimatic conditions for numerous organisms, such as small mammals, birds and invertebrates.

A range of ungulate species inhabit the northern European forested areas and their influence on the forests is generally considered to be significant. Climatic aspects, such as snow depth, may restrict distributions of species and therefore also interact with the ecological functioning of the forest systems. However, because the chains of influences and responses have proven to be highly complex and often nonlinear, it is generally difficult to predict how alterations of basic climatic conditions may affect the ungulate communities and the ecosystems of which they are part.

For certain, climate change may will alter prerequisites for wild ungulates of Europe, which subsequently may affect all forest biodiversity. Vegetation composition and plant species distributions may shift as results of altered growing conditions. On the finer scale, nutrient contents of forage for ungulates may change, which may force the animals to change their foraging strategies and food choice in order to obtain balanced diets. Moreover, ungulates may face new or intensified stress factors, such as parasites, competing species, heat and drought.

Forestry is a chief land use within the boreal and temperate zones of Europe and in general strongly affects many forest characteristics, primarily tree species composition, light conditions, soil properties and water. For ungulates, method of silviculture has been recognized as a key agent for determining the local browse availability, both its abundance and its quality. This creates feedback loops by subsequently affecting the browsing pressure. Forestry may therefore be of fundamental importance for mitigation of negative effects of climate change on wild ungulates. Simultaneously, the ungulates hamper, by their damage to young trees, the forestry's goal to mitigate climate change. Wise management made jointly by

forests and ungulate stakeholders will be essential for counteracting unwanted effects on the forest biodiversity and the ecosystem services they provide.

Currently, knowledge is scarce and predictions are scattered regarding interactions between production forestry and northern European ungulates in a warmer climate. The NEFUN network in its current constellation has been active since January 2020, involving eleven researchers from nine research institutions in six countries (Sweden, Norway, Finland, Germany, France and Poland). The purpose with our network is to synthesize existing, and develop new, research into potential climatic induced changes in the ungulate browsing regime and the consequences for sustainability and adaptation of the forestry sector.

b) A description of the main activities of the network

We have two goals with our network meetings; (1) knowledge syntheses and (2) knowledge strategies. Part (1) concerns an exchange of expertise within the group, a systematic synthesis of published findings and an identification of research gaps. Part (2) concerns an exploration of funding options and usefulness of potential consortium compilations, in order to create and submit international project applications.

Since we obtained the support from SNS, we have had regular digital meetings (for which we have detailed documentation):

- 15 March 2021
- 15 April 2021
- 21 May 2021
- 1 June 2021
- 1 September 2021
- 22 October 2021
- 29 October 2021
- 26-27 November 2021 (2-day digital workshop, insted of a cancelled physical meeting in Poland)
- 20 January 2022
- 4 March 2022
- 28 March 2022
- 2 May 2022
- 10 June 2022
- 17 August 2022
- 31 August 2022

Due to corona, our planned conference was postponed several times. We finally managed to get together in person 27-29 May 2022, at the Abisko Research Station in northern Sweden. The reason for choosing Abisko is that it hosts world-class climatic research activity. We had a very fruitful 2-day meeting, during which we not only proceeded strongly with our tasks, but also enjoyed a guided tour of field sites and facilities by Prof. Keith Larsen, director at the Climate Impacts Research Centre.

We decided early on in 2021 that by first systematically assessing the status quo of the complex knowledge involved (Part 1), the network will get an in-depth overview of the research needs, instead of jumping on a bandwagon and risk repeating research. For that reason, we have during our meetings focused mostly on a knowledge synthesis project, in which we all participate in an ambitious and thorough systematic literature review. We have however identified calls for funding at an EU level which are relevant for us, and we spent time in Abisko making a strategic plan for this. As we have obtained a continuation of the SNS funding (N2022-06), we aim to spend more of our time now in 2022 on a joint grant application to Biodiversa (Part 2). We already have a draft for the first stage application due this autumn, and we have secured collaboration by additional partners necessary for the call. We also aim to work on popular dissemination (social media, articles in national languages targeting stakeholders), provided funding for work expenses can be obtained.

## Outcomes

6. Published outputs achieved as a consequence of the network (peer-reviewed articles, other publications)

We are currently working on a manuscript that we aim to submit before the end of the year, to the international, peer-reviewed journal Global Change Biology. It is a systematic review of research into climate change effects on ungulates, focusing on the northern hemisphere and the boreal biome.

7. Other practical outputs of the network (workshops, conferences, scientific meetings, policy recommendations, conferences, large-scale project applications, websites or databases etc.)

1. A two-day (digital) workshop in November 2021
2. A two-day conference in May 2022 in Abisko
3. A large-scale project application to Biodiversa (EU) in process
4. NEFUN was represented by Anders Mårell at the French-Swedish Conference on Forests in Umeå, 30-31 May 2022, as he was an invited speaker on the role of ungulates in forest ecosystems.

8. How and within which areas was the network beneficial for the Nordic region (Denmark, Finland, Iceland, Norway, Sweden and the autonomous areas of the Faroe Islands, Greenland and Åland Islands)?

Our network includes researchers and institutions in Sweden, Norway and Finland (as well as Poland, France and Germany). The research topic we explore – climate change impacts on ungulates and forests – is of great importance for these Nordic countries, and we believe that our findings will be appreciated by government authorities and managers in each country. Thanks to the network we have established new connections among institutions, and strengthened those that were already there. New ideas for collaboration have been created (external to NEFUN). We have also benefited from each member's own professional network, for example with regards to recruitment of new staff.

9. Provide a popular science piece for dissemination in SNS' various channels (maximum 700 words) *with emphasis on application of results and benefits for the Nordic society.*

Provide pictures (size at least 500x500 pixels and resolution at least 72 pixels) as separate files (.jpg). Include caption to each picture, including the name of photographer.

Large wild herbivores, such as ungulates, can be major drivers of biodiversity and forest ecosystem services. Ungulates can influence vegetation composition, nutrient recycling, habitat structure and thus also microclimatic conditions for numerous organisms, such as small mammals, birds and invertebrates. A range of ungulate species inhabit the northern European forested areas and their influence on the forests is generally considered to be significant, which has repeatedly been confirmed in, for example, various exclosure studies (see photo, from Larvik, Norway).

Human-induced climate change is likely to influence such patterns. For example, changes in snow depth may affect distributions of ungulate species and therefore also interact with the ecological functioning of the forest systems. In a future climate, vegetation composition and forage plant species distributions may shift as results of altered growing conditions. On the finer scale, nutrient contents of forage for ungulates may change, which may force the animals to change their foraging strategies and food choice to obtain balanced diets. Moreover, ungulates may face new or intensified stress factors, such as parasites, competing species, heat and drought.

At the same time, the ungulates' forest habitat is strongly affected by forestry in this region, primarily due to effects on tree species composition, light conditions, soil properties and water. For ungulates, method of silviculture has been recognized as a key

agent for determining the local browse availability, both its abundance and its quality. Simultaneously, the ungulates hamper, by their damage to young trees, the forestry's goal to mitigate climate change.

The NEFUN network aims to gather established research groups to better compile the existing knowledge regarding interactions between production forestry and northern European ungulates in a warmer climate, and to create new research projects that efficiently target the most crucial missing links. Our knowledge compilation is resulting in a systematic review article in which stakeholders will find a synthesis of all that is known to date about how changes in temperature, rainfall, snow depth and extreme weather events has affected wild ungulates in the boreal biome to date, and prognosis of how they may be affected in the future. In this first paper we reveal important patterns with regards to the animals' physiology, diseases, behavior, movements, migration and also distribution shifts. In our next publication, we will focus on how climate change specifically affects the ungulates' forage, and how all these aspects combine into potential impacts on Nordic forestry, e.g. though damage. These topics are of great interest by policy makers, managers and other members of society in all Nordic countries today, and we believe that our results will be appreciated and beneficial by policy makers and managers alike.

## Participation and inclusion in the network activities

**10. Participants**

| Country | PhD students & Post-docs | Other researchers | Stakeholders | Communication officers | Gender | | | Total |
|---|---|---|---|---|---|---|---|---|
| | | | | | Women | Men | Other | |
| Denmark | | | | | | | | |
| Finland | Markus Melin | Juho Matala | | | | 2 | | 2 |
| Iceland | | | | | | | | |
| Norway | | Hilde Karine Wam, Aksel Granhus, Karen-Marie Mathisen | | | 2 | 1 | | 3 |
| Sweden | Laura Juvany canovas | Annika Felton, Märtha Wallgren | | | 3 | | | 3 |
| Poland | | Zbigniew Borowski | | | | 1 | | 1 |
| France | | Anders Mårell | | | | 1 | | 1 |
| Germany | | Caroline Stolter | | | 1 | | | 1 |
| ... | | | | | | | | |
| ... | | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| … | | | | | | | | |
| Total | | | | | 6 | 5 | | 11 |

## Economic report

| 11. Received grant from SNS (SEK): |
|---|
| 126 000 SEK |

| **12. Costs** | SNS funding | Co-financing | Total |
|---|---|---|---|
| Travel and accommodation | 42842 | | |
| Meeting costs | 21376 | | |
| Communication | | | |
| Other costs (specify)<br>Labour costs | | 126000 | |
| **Total SUM (SEK)** | **64218** | **126000** | **190218** |

| **13. Allocation of SNS funding** | | |
|---|---|---|
| **Country** | **Partner organization** | **% of total** |
| Denmark | | |
| Finland | Natural Resources Institute Finland | 27 |
| Sweden | SLU & Skogforsk | 63 |
| Norway | Norwegian Institute of Bioeconomy Research | 10 |
| Iceland | | |
| … | | |
| … | | |
| … | | |
| **Total SUM** | | **64218** |

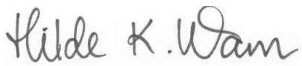
| **14. Economic result (deficit or surplus)** |
|---|
| We were granted 126 000 SEK. Due to corona and other reasons making it hard for several members to attend the conference in person, our costs were smaller than expected. The result is therefore a surplus of 61 782 SEK |

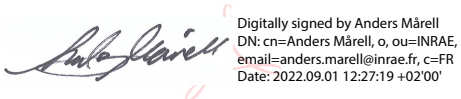
| Optional: Comments to the economic reporting |
|---|
| Unfortunately, only six of us were able to travel to Abisko and attend the conference in person. The others joined the conference online. Those of us who attended in person represented Sweden (Märtha Wallgren, Laura Juvany Canovas and Annika Felton), Norway (Aksel Granhus) and Finland (Juho Matala and Markus Melin). Therefore, the cost distribution of our grant only concerns these three countries. |

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

| Signature of the main applicant | | |
|---|---|---|
|  | SLU | 2022-09-01 |
| Signature | Organization | Date |
| Annika Felton | | |
| Printed name | | |

| Signature of the department head at the department of the main applicant | | |
|---|---|---|
| | SLU | 2022-09-01 |
| Digitally Signed below | | |
| | Organization | Date |
| Giulia Attocchi | | |
| Printed name | | |

| Second applicant's signature, place and date | | |
|---|---|---|
|  | Norwegian Institute of Bioeconomy Research | 2022-09-01 |
| Signature | Organization | Date |
| Hilde Karine Wam | | |
| Printed name | | |

| Third applicant's signature, place and date | | |
|---|---|---|
|   | INRAE, France | 2022-09-01 |
| Signature | Organization | Date |
| Anders Mårell | | |
| Printed name | | |

| Forth applicant's signature, place and date | | |
|---|---|---|
| Zbigniew Borowski | Forest Research Institute, Poland | 2022-09-01 |
| --- | --- | --- |
| Signature | Organization | Date |
| Zbigniew Borowski | | |
| --- | | |
| Printed name | | |

| Fifth applicant's signature, place and date | | |
|---|---|---|
| | | |
| --- | --- | --- |
| Signature | Organization | Date |
| Caroline Stolter | | |
| --- | | |
| Printed name | | |

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