

Final report for SNS research projects 2025-2027

Submit the report to sns@slu.se by 24:00 CET, 1st of March, 2028, at the latest.

The report should not exceed 3500 words (including words in the template).

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

1. Project title:	Understanding the role and interplay of forest microclimates for successfully balancing productivity and biodiversity among Nordic forest landscapes (ForestMicroClim)
2. Project code:	SNS132
3. Project coordinator:	Dr. Robert John Lewis
Email:	robert.lewis@nina.no
Institution:	NINA – Norwegian Institute for Nature Research

Activity report

4. Provide a project summary for the whole project period, including:

a) The purpose of the project/main problems/hypothesis addressed

ForestMicroClim was initiated to address a central challenge in Nordic forestry: how to balance timber productivity with biodiversity conservation under climate change. While macroclimatic drivers of biodiversity patterns are relatively well studied, forest microclimates – the fine-scale temperature and moisture conditions experienced beneath forest canopies – remain poorly integrated into both ecological modelling and forest management frameworks.

The project aimed to:

1. Quantify how forest microclimate heterogeneity varies along gradients of forest productivity and management intensity across Scandinavia.
2. Evaluate whether microclimate heterogeneity supports biodiversity and functions as an ecosystem service in its own right.
3. Improve findability and accessibility of forest microclimate data through decentralized digital infrastructure.
4. Develop new approaches to communicating and interpreting ecological data.

The project operated at the interface of forest ecology, macroecology, data governance, and interdisciplinary knowledge production.

b) A short description of the main activities of the project

The project evolved substantially over its lifetime (2022–2025), responding to rapid developments in microclimate science and digital research infrastructures.

WP1 – Microclimate and Biodiversity

Activities included:

- Assembly and standardisation of forest microclimate data from Nordic plots.
- Integration of biodiversity data across vascular plants, bryophytes, lichens and fungi.
- Contribution of standardized data to the global SoilTemp network.
- Exploratory modelling of biodiversity responses along forest productivity gradients.

During the project period, advances in the broader field (e.g. Haesen et al. 2023) reduced the added value of certain originally proposed modelling components (notably specific downscaling approaches under Objective 2). In response, these components were not further pursued. Instead, emphasis shifted toward empirical data integration and broader macroecological synthesis.

While the full biodiversity gradient synthesis was not finalized within the SNS132 timeframe, substantial groundwork was completed and continues to inform ongoing collaborations.

WP2 – Data Governance and Digital Infrastructure

WP2 developed beyond its original scope and became one of the strongest outcomes of the project.

Key achievements include:

- Development and publication of the EckoChain specification (Methods in Ecology & Evolution).
- Publication in Scientific Data on incentivising open ecological data.
- Contribution to the conceptual and technical foundations of decentralized ecological data management.
- Integration of forest microclimate data streams into broader international data initiatives.
- Securing EU Biodiversa+ funding (ForestWeb3.o), directly building on SNS132 work.

Although originally envisioned as a fully decentralized blockchain-based consortium, implementation matured in a more pragmatic direction. The blockchain architecture functions as specified in the peer-reviewed publication but is not yet distributed or decentralized in operational terms. Instead, it serves as a transparent metadata and access ledger framework whose further development continues under EU funding

The originally envisioned formal Nordic microclimate consortium did not consolidate into a permanent structure. However, collaborations with key partners (notably SoilTemp and EU Biodiversa+ networks) continue beyond the SNS funding period.

Artistic Engagement Initiative (Approved Extension 2025)

Following formal approval of a project extension to December 31, 2025, SNS132 incorporated an interdisciplinary artistic engagement initiative.

This resulted in:

- The public exhibition Intimate Atmospheres at the University of Bergen.
- Translation of forest microclimate data into immersive, interactive digital artworks.
- Public documentation and conference dissemination.
- Online dissemination (YouTube documentation and conference presentation).

This initiative extended the project's impact beyond traditional outreach. Rather than simplifying science, it recontextualized ecological data as experiential and interpretive material. This approach explored how forest microclimates can be understood not only as ecological variables but as lived atmospheric conditions.

c) Achieved targets

Achieved:

- Peer-reviewed publications in Scientific Data and Methods in Ecology & Evolution.
- Contribution to Global Ecology and Biogeography and Global Change Biology outputs.
- BISS publication (2025).
- Integration of Nordic microclimate data into international data infrastructures.
- Secured EU Biodiversa+ follow-up funding.
- Realized interdisciplinary artistic exhibition and documentation.
- Extended project to 2025 with approved reallocation and completion of public engagement deliverables.

Partially achieved:

- Empirical biodiversity–productivity synthesis remains incomplete.
- Formal decentralized Nordic consortium was not established.

d) Did the network develop and deliver as planned? If not, please explain why

The network developed differently than originally planned but delivered substantial and durable outputs.

Scientific directions evolved in response to rapid methodological developments in microclimate modelling. Rather than duplicating emerging approaches, the project strategically pivoted toward:

- Empirical data mobilization.
- Digital infrastructure innovation.
- Governance models for open ecological data.

While the original Nordic consortium structure did not formalize, core collaborations strengthened and expanded into European-scale initiatives.

Overall, the project's legacy is stronger at the intersection of ecology, data governance, and interdisciplinary engagement than originally envisioned.

5. List the published outputs achieved as a consequence of the project (peer-reviewed articles, other publications)

Direct

Lewis et al. 2023. Scientific Data. 10, 591. <https://doi.org/10.1038/s41597-023-02496-2>

Krauth & Nelson 2025. Biodiversity Information Science and Standards 9: e175400. <https://doi.org/10.3897/biss.9.175400>

Indirect

Lewis et al. 2025. Biodiversity Information Science and Standards 10: e183778. <https://doi.org/10.3897/biss.10.183778>

Marstein et al. 2024. Methods in Ecology & Evolution. <https://doi.org/10.1111/2041-210X.14280>

Greiser et al. 2023. Agricultural and Forest Meteorology 345: 109828. <https://doi.org/10.1016/j.agrformet.2023.109828>

Christiansen et al. 2023. Journal of Vegetation Science 34: e13197. <https://doi.org/10.1111/jvs.13197>

Gril et al. 2023. Methods in Ecology & Evolution 14: 885–897. <https://doi.org/10.1111/2041-210X.14048>

Haesen et al. 2023. Global Change Biology 29: 2886–2892. <https://doi.org/10.1111/gcb.16678>

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

Integration with SoilTemp (MEB) network. <https://meb-network.com/>

Development of EccoChain specification.

EU Biodiversa+ ForestWeb3.0 project. <https://www.biodiversa.eu/2024/04/15/forest-web-3-0/>

Public exhibition Intimate Atmospheres. <https://www4.uib.no/en/research/research-centres/center-for-digital-narrative/events/intimate-atmospheres>

<https://www.youtube.com/watch?v=-nAzMp6gHD4>

Invited Leonardo LASER Talks Bergen seminar.

<https://leonardo.info/civcrm/event/info%3Fid%3D1025%26reset%3D1>

Conference dissemination and recorded presentations. <https://youtu.be/iXAsogmggDs>

Cross-disciplinary collaboration with the Center for Digital Narrative (University of Bergen).

<https://www.youtube.com/watch?v=uALb7J6lpO8>

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

The project contributed to the Nordic region by:

1. Strengthening cross-Nordic research collaboration in forest microclimate science.
2. Developing conceptual and technical tools aligned with FAIR ecological data principles.
3. Supporting foundations for next-generation forest monitoring and biodiversity accounting systems.
4. Enhancing ecological literacy through innovative interdisciplinary engagement.

ForestMicroClim contributed to positioning Nordic forest research at the intersection of ecological science, digital infrastructure, and public engagement.

Participation

8. Number of participants involved in the project activities

(Please adjust the table with countries to match your project)

Country	Early-career researchers/ PhD students	Senior researchers	Stakeholders	Others (specify)	Gender			Total
					Women	Men	Other	
Denmark								
Finland	1				1			
Iceland								
Norway	2				1	1		
Sweden	1				1			
...								
...								
...								
Total	4				3	1		

Gender equality actions

In the beginning of the project period, you were introduced to the [gender equality guidelines](#) and asked to perform at least five points from the action step during the whole project period. Fill in the following evaluation scheme with the actions performed. It is new for SNS to introduce these gender equality guidelines to our funded projects, so SNS would really appreciate your feedback on the guidelines and how they have worked for you.

9. Evaluation scheme	
a) Outcome of completed analysis step:	GE analyses was discussed and considered during the application writing and summarised in the proposal document.
b) Outcome of completed planning step:	GE planning identified the consortium consists of young parents of both genders, planning of project meetings & timing of deliverables considers time and travel constraints imposed on those with young families.
c) Outcome of completed action steps (please list each action	Support parents through flexible meeting times and promote telepresence when family needs make meetings hard to join. This is always a

point performed and their outcome)	consideration. MEB was planned well in advance helping circumvent these challenges. Take part in SNS' gender equality-related workshops, seminars etc: PI attended SNS led Gender Equality seminars and research dissemination in 2022.
d) How did the actions/tools work for your network:	The gender equality actions and tools worked well for the scale and structure of our network. Because the consortium consisted primarily of early-career researchers, many of whom had family responsibilities, flexible scheduling, advance planning of meetings, and support for remote participation were particularly important. These measures helped ensure that participation remained accessible and that no partner was disadvantaged due to travel or caregiving constraints. The SNS guidelines provided a useful framework for considering these aspects during project planning and coordination and helped maintain awareness of inclusivity in project organisation.
e) How could SNS provide more support to your network in the work toward gender equality:	SNS already are in my view operating at the forefront of this topic and work effectively in ensuring GE is incorporated into the research they support.
f) General feedback to the gender equality guidelines:	None

Economic report

The economic reporting should include the total received grants and costs for the whole project period

10. Received grant from SNS in total (SEK):
900,000 SEK

11. Allocation of SNS funding

Country	Partner/institution	Sum (SEK)
Denmark		
Finland		220
Sweden		220
Norway		460
Iceland		
Other countries (specify)		
Total SUM		900

12. Costs

(in SEK)	SNS funding	Co-financing		Total
		Cash	In-kind	
Travel and accommodation				
Meeting costs		4000		4000
Communication				
Salary and OH	900000		709800	1609800
Other costs (specify)			20000	20000
Total SUM (SEK)	900000	4000	729800	1633800

13. Economic result (deficit or surplus):

- Stockholm University invoiced 161,900 NOK (March 2025).
- Approximately 70,800 NOK remains expected for final billing.
- Temporary balance at NINA: 108,411 NOK.
- Estimated remaining balance after final SLU billing: ~37,611 NOK.

This remaining amount will be allocated to final reporting, administrative closure, and long-term documentation and archiving of scientific and artistic outputs.

No deficit occurred and no surplus anticipated.

14. Optional: Comments to the economic reporting:

In-kind reflects 2024/25 cost reporting.

NINA in-kind : 219000 NOK (150 hours) paid from internal funds

University of Stockholm (514,800 SEK hours / -20 000 SEK for fieldwork logistics and accommodation from internal funds and CG's Formas ForestBuffer project)

15. Submit a popular science piece as a separate document for dissemination in SNS' various channels with emphasis on application of results and benefits for the Nordic society.

Please see separate document for instructions.

I hereby declare that the above statements are true to the best of my knowledge
 (Please adjust the number of signature boxes to the number of applicants)

Signature of the main applicant/project coordinator

[Handwritten signature]

Signature

NINA

Institution

12/3/2026

Date

Robert John Lewis

Printed name

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

[Handwritten signature]

Signature

MNA

Institution

12/3-2026

Date

GEIR HELGE SYSTAD

Printed name

