Biodiversity and human well-being in nature-based solutions – experiences from the NBSPLUS project in Malmö (Sweden)

Zedda Luciana[1]*, Höss Sebastian[1], Cetinic Katarina A.[2], Hawley Kate[2], Tamm Kaidi[3], Tuhkanen Heidi[3], Sonesson Ludwig[4], Ehrnstén Therése[4], Nilsson Daniel[4], McKnight Ursula S.[5]

1 Institute for Biodiversity–Network (ibn), Regensburg, Germany; 2 Section for Freshwater Ecology, Norwegian Institute for Water Research (NIVA), Oslo, Norway; 3 Stockholm Environmental Institute–Tallinn Centre (SEI), Tallinn, Estonia; 4 City of Malmö, Malmö, Sweden; 5 Swedish Meteorological and Hydrological Institute (SMHI), Norrköping, Sweden; * (presenting author)

Contact: Project lead, Dr. Ursula McKnight (ursula.mcknight@smhi.se), **Website:** https://www.smhi.se/en/research/research-units/hydrology/research-projects/nbsplus---nature-based-solution-services-promoting-local-biodiversity-well-being-and-scalable-solutions

The Biodiversa+ project **NBSPLUS** co-develops transdisciplinary methods and tools, with the intent to embed them within existing governance structures, to ensure clear pathways exist that can support the implementation of multifunctional nature-based solutions (NBS). It aims to establish the concept of **'NBS services',** enabling information synthesis from a range of sources and integrating biodiversity, justice, and well-being into rural and urban resilience planning. NBSPLUS synthesizes existing knowledge through a comprehensive literature review and explores the value of lichens and nematodes as novel biodiversity indicators for a terrestrial-freshwater cross-habitat monitoring framework, complemented by a resident survey and participant observations to assess links with societal well-being. Work is carried out in three use-cases in Europe (Malmö, Valencia) and Canada (Québec) that span different geographical and climatic conditions, and institutional/decision contexts. The project promotes inclusive stakeholder engagement (SE) and societal anchoring through educational resources and citizen science (CS) initiatives. CS is used to test cost-effective, transnationally valid biodiversity monitoring and to map social implications of NBS for a deeper understanding of local context and socio-ecological interlinkages. Project activities are implemented in collaboration with local stakeholders (incl. citizens) and potential users (e.g. municipalities) of the project results.

The Malmö use case. First investigations were carried out in September 2025 in Malmö, in planned and existing NBS measures located in the Riseberga stream catchment. Riseberga is Malmö's largest stream (12 km), which drains one third of city's surface water. It exhibits fast runoff, due to its narrow and deep character, which is complicated by sealing in industrial and residential areas. Flooding, erosion and poor water quality are some of the challenges facing the area. To address this, the City of Malmö is working to replace grey infrastructure with NBS (and hybrid) measures along the stream, the latter including wetlands, parks and ecological stormwater systems. Projects are ongoing regarding further development and improvement of the area.

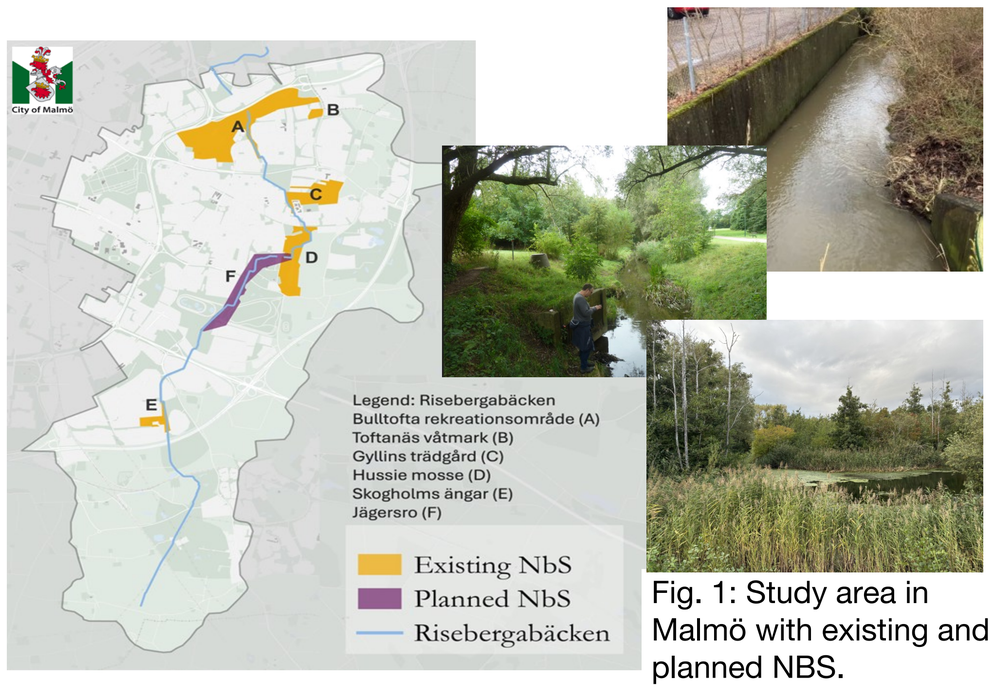

Fig. 1: Study area in Malmö with existing and planned NBS.

NBS services for biodiversity

Preliminary work:

- Literature review to synthesize existing knowledge.
- Drafting sampling and monitoring protocols for nematodes and lichens (epiphytic), developed for scientists and citizen scientists.

Investigations in Malmö:

- Baseline sampling under varying ecological conditions of epiphytic lichens and of nematodes in soil, stream sediment/biofilm, mosses and lichens for evaluating bioindicator effects of NBS interventions.
- Students from Malmö piloted the CS biodiversity protocols providing feedback that improved them through a participatory process.

Next steps:

- Elaboration of collected data (baseline) and evaluation of bioindicators.
- Citizen science activities will be continued, both to engage citizens and for collecting more data on the diversity of epiphytic lichens and nematodes. Provision of learning materials and online trainings.
- Finalization of protocols. Similar work in Spanish and Canadian sites.

NBS services for well-being

Preliminary work:

- Literature review for social impact framework, resulting in evidence brief (Winter 2025).
- Drafting of the citizen science field observation manuals and survey for social impact assessment.

Investigations in Malmö:

- Citizen scientists tested the social impact survey in September 2025, providing feedback that improved the survey materials.
- The social impact survey runs in Malmö in cooperation with the City from November 2025 to September 2026.
- Posters with QR codes placed in the recreational areas around NBS sites invite users to participate in the survey as citizen scientists and share how they perceive the space and capture insights around the NBS, biodiversity and human well-being nexus. Users can take the survey as often as they wish to support the NBSPLUS research project as well as the city in further developing local NBS.

Next steps:

- To validate the observation results and get deeper insights into use, accessibility and justice aspects, a resident survey will run in February and March 2026 in districts neighbouring the Riseberga NBS sites.
- Similar work will be carried out in the Spanish and Canadian sites.

The project will highlight best practices for interconnection and simultaneous consideration of biodiversity and well-being in NBS design. Knowledge synthesis from Malmö and from the other use cases will support scientifically-grounded NBS design and evaluation processes, integrating governance, biodiversity, well-being and climate conditions, and support the development of a participatory, simulation-guided adaptive co-management framework. Results will also be shared through openly accessible learning modules to facilitate knowledge transfer and adoption by stakeholders across Europe and globally.

This research was funded by Biodiversa+, the European Biodiversity Partnership, in the context of the NBSPLUS project under the 2023-2024 BiodivNBS joint call. It was co-funded by the European Commission (GA No. 101052342) and the following funding organisations: The Swedish Research Council for Environment, Agricultural, Sciences, and Spatial Planning (Formas), Fundação para a Ciência e a Tecnologia, I.P., Research Council of Norway, Agencia Estatal de Investigación; Fundación Biodiversidad, Estonian Research Council, Fonds de Recherche du Québec (FRQ). IBN, partner and subcontractor, has been co-financed by FORMAS, Agencia Estatal de Investigación; Fundación Biodiversidadand, and FRQ.