VIII international meeting on *Sphagnum* biology

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Abstract Booklet

NINA
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Opening session

Sphagnum research – from obscure to mainstream in 60 years

Speaker Håkan Rydin, Uppsala University, Sweden, Hakan.Rydin@ebc.uu.se

Abstract In the 1960s *Sphagnum* ecology largely dealt with their role in vegetation. But in the 1960s interest rose in the peculiar physiology of the genus, culminating in seminal papers by Dicky Clymo. Niche separation and the role of *Sphagnum* in the peatland community developed in the 1970s, but still as a somewhat odd scientific subculture. Ecophysiological papers appeared in the 1980s as modern gas exchange techniques developed, and environmental debates triggered ecophysiological research on effects of nitrogen and sulphur deposition. Isozyme studies started to reveal local dispersal and population patterns. The role of *Sphagnum* in the global carbon cycle was recognized (but not by many) in the early 1990s (actually already in 1980 in a little known paper by Hugo Sjörs). This led to today's hype in the effects of climate on *Sphagnum* (and vice versa), both in experimental research and with a renewed interest in paleoecology. At the same time habitat losses (which had been going on for centuries) stimulated a new interest in *Sphagnum* regeneration as methods were developed to re-vegetate cutover peatlands. This expanded to wider research in restoration ecology, with the aim to restore biodiversity or carbon sequestration. Hence, the research has become an important part of general ecosystem ecology. After these decades the links between morphology, physiology and ecology are better known in *Sphagnum* than in most plants of ecological importance. In addition, genomic and phylogenetic knowledge have developed in close connection with ecology. As a result, *Sphagnum* ecologists have gradually entered the mainstream in community and population ecology with studies in, for example, dispersal, local adaptation, trait evolution.

Session 1 *Sphagnum* systematics and genomics

The *Sphagnum divinum* and *S. medium* in Europe

Speaker Jon Shaw, Duke University, USA, shaw@duke.edu

Authors Jon Shaw, Blanka Aguero, Marta Nieto-Lugulde, Aaron Duffy, Gustaf Granath

Abstract In 2017-2018 the "Trondheim *Sphagnum* Team" showed that European plants generally known as *Sphagnum magellanicum* more accurately belong to *S. divinum* and *S. medium*, and that the true *S. magellanicum* is restricted to Tiera del Fuego. They also showed that both *S. divinum* and *S. medium* occur in North America. We continued research on this group using whole genome sequencing and RADseq and showed that in North America two additional undescribed species occur, and these were described as *S. diabolicum* and *S. magniae* (named for Magni Kyrkjeeide). Additional sampling indicates that *S. diabolicum* and *S. magniae* are eastern North American endemics. The distributions, reproductive biology, and genetic structure of the four North American species of this complex have been extensively studied, but less is known about *S. divinum* and *S. medium* in Europe. We used a combination of molecular approaches to document European *S. divinum* and *S. medium* and here report that based on RADseq: (1) 345 samples (ramets) represent 273 different genets, of which 123 (genets) were assigned to *S. divinum* and 150 to *S. medium*. Both species occur as far south as southern France and *S. divinum* reaches northern Spain. (2) *S. divinum* contains more genetic diversity than *S. medium*. (3) Neither species show gametophyte sex ratio biases. (4) Both species exhibit significant population-level genetic differentiation relative to both physical separation and climatic differences. (5) Comparisons among demographic models suggest low but significant amounts of recent (and/or current?) hybridization between *S. divinum* and *S. medium* following their initial reproductive isolation.

Demographic models reveal recent gene flow between geographically sympatric *Sphagnum warnstorfii* and *S. talbotianum*

Speaker Karn Imwattana, Chulalongkorn University, Thailand, karn.imwattana@gmail.com

Authors Karn Imwattana, A. Jonathan Shaw

Abstract *Sphagnum warnstorfii* Russ. is one of the most common peat mosses in the Northern Hemisphere. Unlike the majority of *Sphagnum* species, *S. warnstorfii* thrives in medium to rich fens that have high nutrient and pH levels. The distribution of *S. warnstorfii* is very broad, covering all continents in the North Hemisphere, both in boreal and Arctic regions that were largely covered by glaciers. A previous study using genomic data (RAD-seq) showed that *S. warnstorfii* consists of two genetically distinct lineages: boreal and Arctic groups that differ somewhat in morphology and suggested that the two morphs emerged from vicariant divergence in different glacial refugia during the last glacial maximum (LGM). However, limited sampling of the Arctic group limited their conclusions. This study employed RAD-seq data that extensively covers the distribution of *S. warnstorfii*, both in boreal and arctic regions. Our study demonstrated that the "arctic group" of *S. warnstorfii* is conspecific with *S. talbotianum* Andrus. Analyses of demographic models using simulations of site frequency spectra showed that *S.*

warnstorfii and *S. talbotianum* were reproductively isolated after divergence, and interspecific gene flow occurred recently and was limited to Alaska, where the two species are geographically sympatric. Interspecific gene flow occurred in one direction from *S. talbotianum* to *S. warnstorfii* and could have contributed to the adaptation of *S. warnstorfii* to Arctic conditions. The population size of *S. talbotianum* is larger and has undergone a less intense population bottleneck than *S. warnstorfii*, supporting the hypothesis that Beringia can harbor large and stable plant populations during the last glacial maximum. The two species are morphologically differentiated. Our results support *S. talbotianum* as a separate species from *S. warnstorfii*.

Molecular species delimitation and polyploidy determination of *Sphagnum* subgenus *Subsecunda* in Europe

Speaker Magni Olsen Kyrkjeeide, Norwegian Institute for Nature Research, Norway, magni.kyrkjeeide@nina.no

Authors Magni Olsen Kyrkjeeide, Olena Meleshko, Hanne Torsdatter Petlund, Kjell Ivar Flatberg, Kristian Hassel, Line Birkeland, Sarah L. Foredyce Martin

Abstract The use of molecular data, often in combination with morphological examination, has resulted in numerous taxonomic revisions within *Sphagnum* the last decades. In Europe, the taxonomic status of *Subsecunda* needs to be resolved. While *Subsecunda* is the most species rich subgenus worldwide, it is only represented by six species in Europe: *S. auriculatum* Schimp., *S. contortum* Schultz, *S. inundatum* Russow, *S. platyphyllum* (Lindb. ex Braithw.) Warnst., *S. pylaesii* Brid., and *S. subsecundum* Nees. However, the name *S. denticulatum* Brid. is commonly used for *S. auriculatum* in Central Europe, and may also comprise *S. inundatum*, Moreover, Russow also described *S. gravetii* in 1894, but is has been synonymized with *S. auriculatum*. Using molecular data, our aims are to confirm the ploidy level of *Subsecunda* species in Europe, investigate if specimens collected as *S. denticulatum* and *S. auriculatum* are conspecific, and explore whether *S. gravetii* is genetically distinct from other *Subsecunda* species. We also aim at identifying parental species of the diploid *Subsecunda* species among the haploid species. Our results support five genetic taxa of *Sphagnum* subgenus *Subsecunda* in Europe, excluding *S. pylaesii* var. *seoides*. Three species are haploid, while two species are diploid. The three haploid taxa correspond to the morphological description of the species. The genetic data clearly indicate that *S. gravetii* belongs to *S. inundatum* and that *S. auriculatum* and *S. denticulatum* are conspecific. We hereafter use *S. denticulatum* as the species name, as this name is the oldest. *Sphagnum denticulatum* and *S. inundatum* had overall a high number of heterozygous loci, strongly indicating that both are allopolyploids. One specimen of *S. auriculatum* from the Azores was homozygous at all loci. This indicates that there is an undescribed, haploid *Subsecunda* in Europe.

Session 2 The role of *Sphagnum* in peatland restoration

Sphagnum species recovery after hydrological regime stabilization in Sudas-Zviedru Mire in Latvia

Speaker Liga Strazdina, Botanical Garden of the University of Latvia, Latvia, liga.strazdina@lu.lv

Authors Liga Strazdina, Mara Pakalne

Abstract Gauja National Park is the largest protected nature area in Latvia with a total area of 91,787 ha. Out of more than 90 mires in territory, the largest is Sudas-Zviedru Mire with an area of 3516 ha. Three mire habitat types are represented here - springfens, transition mires, raised bogs. Origin of territory dates to beginning of Holocene 10,300 years ago. It is one of the oldest raised bog ecosystems in Latvia with an average peat layer depth of 4 m, but the deepest part is almost 12 m. In the 1930s, relatively large human activity and peat mining took place in bog, as a result, dense system of drainage ditches was installed. Although some of ditches are overgrown with *Sphagnum* and mire vegetation, they are still functional, water is carried away from mire. As part of project LIFE13 NAT/LV/000578, LIFE Wetlands, 67 dams were built in 2017 to reduce impact of drainage ditches. In 2014, permanent vegetation and hydrological monitoring releves were established to assess the impact of management measures. Monitoring was repeated in 2015, 2017, 2018, 2020, 2023, and 2024 (measurements of the last two years were carried out within LIFE21-CCM-LV-LIFE PeatCarbon project). Monitoring results indicate an increase in *Sphagnum* cover and species diversity in restored area of degraded raised bog habitat, especially in and along blocked ditches. In total, twelve different *Sphagnum* species have been found in this mire. The most common is *Sphagnum medium*, which occurs mostly in lawns with *S. angustifolium* and *S. flexuosum*, while *S. rubellum*, *S. fuscum* and *S. capillifolium* form hummocks. Wide hollows are found between the ridges, filled by *S. tenellum* and *S. cuspidatum*. The dominant species in transition mires are *S. teres* and *S. fallax*. Other species such as *S. palustre* and *S. papillosum* are found in bog woodland.

Recovery of *Sphagnum* mosses in the donor sites after the cutting

Speaker Edgar Karofeld, Kai Vellak, University of Tartu, Estonia, edgar.karofeld@ut.ee

Authors Edgar Karofeld, Kai Vellak

Abstract There is a consensus, if local conditions allow, to restore extracted peatlands towards re-paludification. The Moss Layer Transfer Technique has shown good results for re-establishing *Sphagnum* carpet in restored extracted peatlands. This technique involves cutting *Sphagnum* fragments from the donor site and spreading them on the restoration site. But do *Sphagnum* mosses recover in the donor sites after cutting? We studied the recovery of the three most common *Sphagnum* species in two donor and natural bog sites in Central Estonia. Length increment (mm yr-1) of *Sphagnum* shoots in the donor sites was smaller (on average by 27 % for *S. fuscum*, 52 % for *S. rubellum* and 40 % for *S. medium*) than in the natural sites. Growth was significantly correlated with water table depth in the natural sites, but no significant relationship was detected in the donor sites. The weight of *Sphagnum* capitula was, in most cases, smaller in the donor sites. The density of *Sphagnum* cover (number of capitula per dm2) was smallest for

S. medium with big capitula with no difference between natural and donor sites. The density of *S. fuscum* and *S. rubellum* was significantly lower in the donor sites. After cutting, the plant cover of the donor sites is dominated by vascular plants, whereas *Sphagnum* cover reached 40-50 % within ten years in Soosaare bog and within five years only 5 % in Punasoo bog. Newly established mosses in the donor sites do not have enough long shoots to reach the water table, although ~10 cm higher than in natural sites, for constant capillary water supply. *Sphagnum* mosses in donor sites depend more on irregular precipitation and can suffer from the draughts even more than in a natural bog. Therefore, we need to understand how to select the donor sites for their better recovery.

From bottles to field

Speaker Yue Sun, East China Normal University, Shanghai, China, ysun@bio.ecnu.edu.cn

Authors Yue Sun, Jiao Li, Yuan Fan, Limin Zhang, Ruiliang Zhu

Abstract To restore the natural *Sphagnum* communities, a certain quantity of seedlings is required. Tissue culture serves as the most efficient source of *Sphagnum* seedlings. We have analysed the regeneration process of *Sphagnum* and developed propagation methods for thalloid protonema and young gametophore, as well as protoplasts isolating. Starting from protoplasm, thalloid protonema, and young gametophore, we can produce numerous small gametophore individuals. However, these individuals have very low survival rates when directly planted in the field. To address this, a method for culture Sphagnum mats were developed. These methods facilitate quick and efficient peat moss cultivation, while also ensuring high survival rates. Additionally, we have studied on the nutritional requirements of *Sphagnum*. By plotting its growth curve, we can discern its nutritional needs and the appropriate nutrient application schedule. This information will benefit for improving the cultivation efficiency of *Sphagnum* and the restoration of peat land.

Sphagnum bioreactors for the production of high-quality founder material for paludiculture

Speaker Juliana Parsons, Plant Biotechnology, Faculty of Biology, University of Freiburg, Germany, juliana.parsons@biologie.uni-freiburg.de

Authors Juliana Parsons, Walja Wanney, Britta Rothgänger, Leon Hanke, Anja Prager, Matthias Krebs, Greta Gaudig, Eva Decker and Ralf Reski

Abstract Rewetting drained peatlands, currently used for agriculture, and stopping peat harvesting can significantly contribute to achieve global climate goals by reducing CO_2 emissions. The exploitation of rewetted peatlands through Paludiculture offers a profitable alternative to the traditional agriculture. For instance, *Sphagnum* farming, the production of *Sphagnum* biomass on rewetted bogs, can substitute the use of peat with renewable material for horticultural substrates. This requires large amounts of high-quality *Sphagnum* founder material, which cannot be collected from natural habitats in the EU, as these are protected. *Sphagnum* material of controlled quality without unwanted biological contaminations can be axenically produced throughout the whole year in photobioreactors. Diverse application

requirements and environmental conditions demand a variety of peat moss species and genotypes as founder material. From our pool of 24 axenic *Sphagnum* species, we are currently investigating the productivity according to the species and provenance (hollow, lawn or hummock) within 12 pre-selected species and also their identification through genetic barcoding. The multiplication rate of the biomass in bioreactors, with at least 30-fold within 4 weeks, is much higher than on the field, and different approaches are being tested to further increase productivity. *Sphagnum* material grown in the bioreactor displays a very high density of innovations (new shoot developing points), and therefore it is an excellent seeding material for *Sphagnum* farming. Our developments may help to further increase the productivity of peat moss in photobioreactors, enhancing the viability of profitable agricultural practices in rewetted peatlands while keeping carbon fixed in the soil.

The role of *Sphagnum* in peatland restoration

Speaker Sorin Ștefănuț, Institute of Biology, Bucharest, Romania, sorinstefanut@gmail.com

Authors Sorin Ștefănuț, Miruna-Maria Ștefănuț

Abstract Institute of Biology Bucharest of the Romanian Academy (IBB) and Norwegian Institute for Nature Conservation Research (NINA) implemented two Economic Area Financial Mechanism (EEA) projects under RO MEDIU Programme – "Environment, Adaptation to Climate Change and Ecosystems", between 2021 and 2024: The "Degraded mires and peatlands restoration of North-East 1 region of Romania (PeatRO2)" project and The "Degraded mires and peatlands restoration of North-West region of Romania (PeatRO4)" project.

The main objectives of the projects were:

- To restore the structure and function within 15 degraded wetland/peatland ecosystems
- Mitigate the effects of climate change in these 15 wetland/peatland degraded ecosystems
- Raising awareness amongst local communities, stakeholders and the general public about the importance of wetland /peatlands
- To support local capacity to mitigate the effects and adapt to a changing climate

As part of the objective of restoring the degraded peatlands, the water drainage channels were blocked, water pools were made and *Sphagnum* samples were replanted for restoration.

Session 3 *Sphagnum* ecology

Effects of soil temperature on *Sphagnum* moss litter quality and decomposition in a subarctic environment

Speaker Sahra Gibson, Uppsala University, Sweden, sahra.gibson@ebc.uu.se

Authors Sahra Gibson, Fia Bengtsson, Michiel Op de Beeck, Nils Cronberg

Abstract High latitude peatlands play a significant role in global soil carbon budgets, attributed to the slow decomposition rate of *Sphagnum* mosses that facilitates carbon sequestration through the build-up of peat. As climate change is predicted to increase soil temperatures and decomposition rates of organic matter, studying environmental and intraspecific mechanisms that control decay resistance of *Sphagnum* mosses is central to understand potential shifts in peatland carbon storage. In this study, we show how soil temperature affects litter quality and decomposition rates of two *Sphagnum* species: *S. papillosum* and *S. subnitens*. We established a reciprocal litter bag experiment over a thermal gradient in Iceland to measure mass loss (%) of the *Sphagnum* moss litters over a 4-month period and used Diffused Reflectance Infrared Transform Spectroscopy (DRIFTS) to analyse the organic chemical structure of the fresh and decomposed litters. The results showed that *S. papillosum* and *S. subnitens* have different rates of decomposition under different soil temperatures which relates to intra- and inter-specific variations in organic chemical structures. *Sphagnum papillosum* decomposed significantly faster in warmer soil conditions compared to colder soil conditions. In contrast, *S. subnitens* did not decompose significantly faster in the warmer soil conditions. There was a significant difference in the organic chemical structure between the hot-originating and cold-originating litter of *S. subnitens*, which was not seen for *S. papillosum*. These results suggest that *S. papillosum* will decompose faster under warmer soil temperatures whereas *S. subnitens* can resist decay due to metabolome plasticity. These findings demonstrate that there are species-specific adaptations to changing environmental conditions that should be considered in climate models.

Drought memory of dementia: the resistance and resilience of the carbon sink function in *Sphagnum*-dominated peatlands during drought succession

Speaker Yvet Telgenkamp, Radboud University Nijmegen, Netherlands, yvet.telgenkamp@ru.nl

Authors Yvet Telgenkamp, Bjorn Robroek

Abstract Over the last decades, droughts have become more frequent and severe, and numerous studies have indicated the detrimental impact of these droughts on the carbon sink function of peatlands. However, the role of more frequent droughts, and particularly successive droughts, on peatland carbon dynamics has been overlooked. Notably, we lack an understanding of the potential for peatland biotic communities to adapt to previous drought events. During drought, the otherwise waterlogged carbon-dense peat is exposed to oxidation processes, severely shifting the delicate balance between carbon uptake and loss. Indeed, droughts can initiate a shift from peatlands as carbon sinks to carbon sources. Peat mosses (genera *Sphagnum*), the dominant species in Northern peatlands – and notably the main primary

producers – play a vital role in maintaining the carbon-sink function. Their productivity, however, relies on sufficient water availability, making them susceptible to drought. Previous experimental research on the effects of drought on peatland C-dynamics has merely focussed on single droughts, while natural drought events differ in duration and are often successive. Droughts potentially cause system acclimatization and increase the robustness of the carbon sink function towards a successive drought. Conversely, drought could reduce the resilience and enhance the state shift from C-sink to C-source. To investigate the role of drought succession in the resistance and resilience of the carbon sink function in *Sphagnum*-dominated peatlands, we performed a mesocosm experiment with *Sphagnum magellanicum** cores from four Northern peat bogs. Our findings add to the understanding of the underlying mechanisms that influence the robustness of the carbon sink function of *Sphagnum*-dominated peatlands during drought.

Effects of plant community changes on *Sphagnum* lipids in an ombrotrophic peatland (Store Mosse National Park, Sweden)

Speaker Carrie Thomas, Radboud University, Netherlands, carrie.thomas@ru.nl

Authors Carrie L. Thomas, Yvet Telgenkamp, Bjorn J. M. Robroek

Abstract Over the last century, lipid hydrocarbons deriving from plant cuticular waxes have been extensively researched and developed into proxy indicators that can be used for paleovegetation and paleoclimate reconstructions. These lipids are typically preferentially preserved compared to other organic molecules and are therefore an important driver and contributor of recalcitrant organic matter. Many factors are known to affect plant lipid compositions, including temperature and precipitation, seasonality, and plant growth stage. As a result, lipid profiles are highly informative of the environmental conditions in which a plant has grown. However, we currently lack detailed studies into the potential effects of the overall plant community composition on the production and distribution of individual plant lipids and consequently, the cumulative lipid biomarker signal deposited in organic matter. We hypothesize that alterations in the plant community will be echoed by changes in plant functional traits, which subsequently will affect individual plant lipids. An ongoing plant removal experiment in the Store Mosse National Park in Sweden provides a unique opportunity to investigate how the removal of the major vascular plant functional types– graminoids and ericoids-- affects the straight-chain lipid and isoprenoid compositions in Sphagnum mosses from lawn and hummock microhabitats. Here, we present our ongoing research that aims to link the lipids composition in the *Sphagnum* carpet to the vascular plant (trait) composition, with the ultimate goal of investigating how such changes affect the organic chemistry of the organic matter in peatlands.

Drivers of *Sphagnum* phyllosphere microbiome composition on a subtropical mountain

Speaker Xiangbo Yin, Philipps university Marburg, Germany, yinxi@staff.uni-marburg.de

Authors Xiangbo Yin, Leeping Ang, Maaike Y. Bader, Lei Shu

Abstract *Sphagnum* is the ecosystem engineer of peatlands, which store around 25% of global soil carbon. The competitive success and productivity of this keystone genus is largely dependent on symbiotic interactions with microbial associates. Specifically, methanotrophic bacteria and nitrogen-fixing bacteria are vital to host sphagna, potentially contributing up to 20–30% of their carbon and nitrogen needs, respectively. While drivers of *Sphagnum* microbiota are starting to be better understood in boreal peatlands, it remains poorly understood in the subtropics. Here, warmer conditions and different seasonal patterns might lead to rather different microbial compositions than in boreal peatlands, even in the same species. Therefore, to determine the drivers of the *Sphagnum* phyllosphere microbiome composition in subtropical climates, we will study the microbiome in four *Sphagnum* species (*S. capillifolium, S. junghuhnianu, S. magellanicum*, and *S. palustre*) within the Baishanzu Nature Reserve (Zhejiang, China). These species are widespread and can be found up into the boreal zone, allowing large-scale comparisons. Locally, we will compare the microbiomes between two distinct habitats (subtropical forest and open stands) and also determine the effects of soil properties (physicochemical and microbial properties), colony characteristics (areas and density), host functional traits (morphological traits, and nutrients), and host identity (species-level and individual-level genetics). We will employ metabarcoding (16S rRNA and ITS regions) and shotgun metagenomics to analyze the structure of bacterial and fungal communities and identify genes involved in carbon and nitrogen cycling, thus providing a comprehensive characterization of the microbiome. Finally, relative contributions of the mentioned factors to the composition of the *Sphagnum* microbiome will be determined and quantified. This project seeks to elucidate the complex interactions among environmental variables, microbiota, and host traits in subtropical *Sphagnum*, thereby enhancing our ability to predict the effects of climate change and human disturbances on the ecosystem services provided by subtropical sphagna.

The role of fructans in stress tolerance and adaptation in *Sphagnum* species

Speaker Camilla Lorange Lindstrøm, Norwegian University of Life Sciences (NMBU), camlin@nmbu.no

Authors Camilla Lorange Lindberg, Magni Olsen Kyrkjeeide, Fia Bengtsson, Wim Van den Ende

Abstract Fructans are crucial metabolites in plants, playing significant roles in stress tolerance and adaptation. Recent research has revealed that *Sphagnum* species produce fructans, a discovery that challenges our understanding of their stress tolerance mechanisms. These storage carbohydrates extend their function beyond mere energy storage, contributing to the stabilization of cellular membranes by integrating into the lipid bilayer, thereby maintaining flexibility and preventing rupture. They support photosynthesis during late autumn and early spring and exhibit reactive oxygen species (ROS) scavenging properties, protecting cells from oxidative damage. Additionally, as osmolytes, fructans help regulate osmotic pressure within cells, ensuring proper cellular function and protection against osmotic stress. Despite these

critical functions, the role of fructans in *Sphagnum* species remains poorly understood. Preliminary data indicate variations in fructan profiles among *Sphagnum* species sampled from hummocks and wetter hollows within the same bog. The production of inulin-type fructans, which can hydrolyze into fructose and sucrose, provides a rapid source of carbon and energy, particularly under stress conditions. The synthesis of small inulin-type fructans in *Sphagnum* is facilitated by the actions of two fructosyl transferase enzymes, 1-SST and 1-FFT. This process is typically linked to specific mutations near the active site of vacuolar invertases (VIs), converting these enzymes into fructosyl transferases (FTs). While FTs have been extensively studied in vascular plants, their presence and function in bryophytes remain unexplored. Remarkably, an analysis of available *Sphagnum* genomes has revealed an unusually high number of putative FT genes, far exceeding what is typically found in fructan-accumulating vascular plants. Moreover, there is significant variation among the predicted FTs across different *Sphagnum* species, which may relate to species-specific inulin patterns. Understanding the relationship between FT activity and its functional implications in *Sphagnum* may reveal important insights into adaptations to extreme environments. Characterizing FTs will enhance our knowledge of *Sphagnum* evolution and the development of functional traits in response to environmental challenges. This research could also identify species better suited for effective carbon sequestration and higher drought tolerance in restoration projects. By investigating fructan profiles and their functional implications, we aim to uncover how *Sphagnum* species adapt to and thrive in extreme environments, ultimately contributing to our understanding of plant evolution and functional trait development in response to environmental challenges.

Lots of water, why are most *Subsecunda* in the Netherlands rare?

Speaker Rudi Zielman, ZiMVo, rudi-zielman@wxs.nl

Authors Rudi Zielman, Wendy de Vroome

Abstract After completion of the Dutch “Veenmosflora” (2002) it became clear that instead of *Sphagnum subsecundum* s.l. the most common species in the section in The Netherlands is *S. denticulatum*. *S. platyphyllum* is extremely rare, know recently from two sites. Also *S. subsecundum* s.s. is very rare, *S. contortum* can be locally frequent. *S. inundatum* was not recognised, but seems to be the second commonest species and *S. denticulatum* is by far the most common species in The Netherlands. Intrigued by the pattern of occurences where *S. platyphyllum* always is accompanied by *S. denticulatum* and *S. subsecundum* often grows in close vicinity of *S. contortum*, we have tried to find factors that can explain the differences in occurences. Due to the extreme rarity of *S. platyphyllum* and wide occurrence of *S. denticulatum* we have restriced our searches to sites with *S. subsecundum, S. inundatum* and *S. contortum*. We made vegetation relevés and conducted measurements for pH and conductivity. Both *S. subsecundum* and *S. contortum* are often accompanied by *S. inundatum*. Vegetations were marshes and fens. Conductivity and pH measurements for *S. subsecundum, S. inundatum, S. contortum* range from 110-430, 110-430, 65-360 µS/cm and 4.3-6.6, 4.3-6.4, 4.2-6.4 respectively. None of these factors can explain the differences in occurrence, thus leaving this open for discussion.

Closing session

Morphophysiological and functional responses of *Sphagnum* to warming and cooling: A reciprocal transplant experiment between two peatlands with different altitudes

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Abstract *Sphagnum* mosses, the most efficient plants for soil carbon sequestration, show a clear distribution differentiation along the altitudinal gradient in the Changbai Mountains, northeastern China. However, a mechanistic understanding of the contrasted altitudinal distribution pattern and carbon sink function response of the ecosystem to climate change is still lacking. Here, three *Sphagnum* species, including two narrow-range species *S. fuscum* (a high-altitude plant) and *S. imbricatum* (a low-altitude plant), as well as a wide-range species *S. magellanicum* (a plant widely distributed across the altitudinal gradient) were chosen as study species. A reciprocal transplant experiment with moss monolith mesocosms (50 cm × 50 cm × 50 cm) between two peatlands with contrasting altitudes (730 m vs. 1475 m) was conducted. Our aim was to examine whether the two narrow-range species and the two ecotypes of the wide-range species can grow well beyond their altitudinal range and how they coordinate carbon allocation to realize their sink function in response to climate change. We found that the low-altitude species and ecotype both showed higher non-structural carbohydrate (NSC) storage and effective PS Ⅱ quantum yield [Y(Ⅱ)] after being transplanted upward, indicating that low temperature does not limit their growth. Unexpectedly, both the high-altitude species and ecotype performed poorly after being transplanted downward, with lower NSC and gross photosynthetic production (GPP). The low-altitude species and ecotype showed unchanged and increased net ecosystem production (NEP), respectively while the high-altitude species and ecotype both showed a decreased NEP mainly because of the decreased GPP. The results demonstrate that colder and wetter climate is not detrimental to the low-altitude species and ecotype and their ecosystem carbon sequestration; warmer and drier conditions impose carbon resource limitations on the high-altitude species and ecotype by impairing their photosynthetic physiological traits and then the NEP of their ecosystems. Overall, under global warming, the survival and carbon sink function of the *Sphagnum* mosses especially those distributed in their warm range margin will be seriously threatened. These findings provide important insights into the mechanisms underlying the altitudinal distribution patterns of *Sphagnum* species and their carbon sink function response to climate change. The observed contrasting responses of the narrow-range and wide-range species highlight the importance of considering species-specific adaptations when assessing ecosystem-level responses to environmental changes.

Down in the bog – Thinking with Peatlands

Speaker Karolin Tampere, University of Tromsø, Norway, karolintampere@gmail.com

Abstract In this multi sensorial presentation the attempt is to share moments from my ongoing curatorial work "Down in the Bog - Thinking with Peatlands» where artists in dialogue with scientists takes us on a deep dive into the curious ecosystem of peatlands. Slowly growing, like peat forming, this is a research project-in-process. It is led by an ambition to make cross-pollinating meeting grounds for contemporary art, environmental issues and the public. The artworks in addition to a program with lectures, concerts and field trips, aim at large to give poetic and imaginative nutrition to contribute creating attention towards the need for increased care of peatland areas, locally, nationally and internationally. Practically and conceptually the topic of peatlands is acting as a guiding map and compass to learn about historical, cultural and contemporary changes in the environments in Sápmi, Northern Norway, Estonia and selected locations internationally.

ABOUT: Karolin Tampere is an artist and curator born in Estonia and currently based in Romsa/Tromsø, Sápmi/Northern Norway. She is part of the long-standing often place-specific collaborations Sørfinnset skole/the nord land and Ensayos. Another trajectory in her artistic and curatorial work is anchored in sonic practices, listening and music.

Karolin is a PhD fellow in artistic research at Tromsø Art Academy - UiT The Arctic University of Norway and The Faculty of Fine Art, University of Bergen. She is also part of the research group Worlding Northern Art (WONA) at the Faculty of Humanities, Social Sciences and Education at UiT - The Arctic University of Norway.

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