How to approach collaborative research on herbivory: an ecological interaction of key importance

Meeting and conference session, Trondheim 1-2 December 2014

Title of meeting: How to approach collaborative research on herbivory: an ecological interaction of key importance
Organizers: Virve Ravolainen, Eeva Soininen, Isabel C Barrio, C Guillermo Bueno, David Hik, Ingibjörg Svala Jónsdóttir, Martin Moersdorf
Location and date: Trondheim (Norway), 1-2 December 2014
Sponsors of the Workshop: IASC Terrestrial Working Group

Summary of activities

The Herbivory Network organized a side meeting and chaired a scientific session during the Arctic Biodiversity Congress in Trondheim, in December 2014. The aim of these activities was to advance the development of a general, standardized protocol for measuring herbivory in tundra ecosystems in arctic and alpine environments, and to strengthen communication with the Circumpolar Biodiversity Monitoring Program (CBMP). The scientific session included expert talks focusing on main groups of herbivores in these systems (i.e. mammals, birds, insects), on long-term ongoing monitoring efforts (such as the Hudson Bay Project; http://research.amnh.org/~rfr/hbp/) and on comprehensive monitoring programs (like the one proposed by the CBMP; http://www.caff.is/terrestrial/terrestrial-monitoring-plan). The session also included a final round table discussion. The side meeting identified the main challenges in the development of a general protocol to measure herbivory and established the next steps for achieving this goal.

Organising these activities was possible thanks to the support of the Terrestrial Working Group of IASC (through early career grants), and the logistics were greatly facilitated by running the event as part of the Arctic Biodiversity Congress. The organising committee was formed by 4 early career researchers and three senior researchers. The activities had great acceptation, with a total of 16 researchers participating in the side meeting (most of them early career researchers; see Appendix 1) and more than 70 researchers attending the scientific session. Overall, there was a broad agreement on the need to develop and implement common and exportable approaches to measuring herbivory in tundra ecosystems. The idea of implementing a simple, ideally not too time-consuming protocol for measuring herbivory as part of already existing monitoring programmes, or as an ad-hoc experimental manipulation, was greatly accepted.

Aim and Motivation

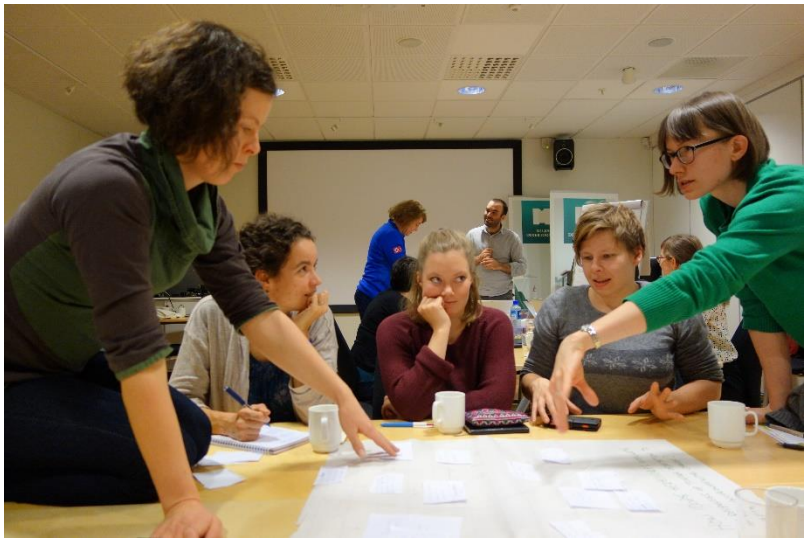
Plant-herbivore interactions can be seen as a core in socio-ecological networks of northern and alpine ecosystems. Ongoing changes in the composition of plant and herbivore communities are likely to alter this biotic interaction and its outcomes and, ultimately, the dynamics of these ecosystems. Recent studies have shown that mammalian herbivory may modulate the responses of tundra plant communities and buffer them against the destabilizing effects of climate change, and it has been suggested that grazing management could be used as a strategy to counteract the effects of warming on tundra vegetation (this topic was actually addressed at the Arctic Biodiversity Congress in the session *How to preserve the tundra in a changing climate*). However, the impacts of herbivory

have shown wide regional variability and many studies suggest that the role of herbivory depends on ecosystem-specific conditions. The causes of this context-dependency are unclear, and partly relate to the diverging study approaches, accentuating the need for harmonized data collection efforts and coordinated research in the circumpolar Arctic.

To date, coordinated monitoring or experimental approaches on biotic interactions, such as herbivory, are at their very beginning. However, recent efforts of several international initiatives give promise to exciting future work with plant-herbivore interactions that will allow teasing apart the seemingly notorious local context-dependence of this biotic interaction. In this sense, the recently established Herbivory Network (HN; http://herbivory.biology.ualberta.ca) aims at promoting collaboration among researchers working on herbivory in arctic and alpine environments. One of the priorities of the HN is to develop common protocols for measuring herbivory across different tundra sites. The need of such approaches was already identified by a group of experts that attended the workshop organized by the HN last April at the ASSW 2014 in Helsinki. A first approach towards the development of a general protocol for measuring the role of herbivory in northern ecosystems was the implementation of a trial version of the ITEX herbivory protocol in summer 2014. The ITEX herbivory protocol was implemented at 7 sites, in 4 different countries. The experience gained in this first field trial will contribute to the development of a more general protocol that will include both experimental manipulations and a network of sites for long-term observations.

The scientific session and side meeting organized as part of the Arctic Biodiversity Congress in Trondheim focused on how to develop collaborative research and monitoring that will increase our understanding of how, when and where herbivores modulate the responses of tundra ecosystems to environmental changes. During the scientific session, different case studies focusing on the main groups of Arctic herbivores and on different monitoring approaches were presented; a round table discussion followed. During the side meeting, the main challenges of developing such a general protocol were identified, and a general framework for the development of the protocol was agreed on. Specifically, the objectives of the session and side meeting were:

- ✓ To develop a general, standardized protocol to evaluate the role of herbivory in northern and alpine ecosystems
- ✓ To identify existing programs and potential collaborators for the implementation of the protocol



The side meeting identified main challenges and discussed specific points for the development of a general herbivory protocol.

Main outcomes and post-meeting activities

The scientific session presented case studies on the main groups of Arctic herbivores: mammals, birds and invertebrates. The different perspectives presented will help develop a protocol that can be applicable to different types of herbivores. The session also provided useful advice on how to develop collaborative research, based on the experience of long-term monitoring programmes, like the Hudson Bay Project, and identified potential links for collaboration with extensive monitoring programmes like the Terrestrial Monitoring Programme of CBMP. During the side meeting the main challenges on developing a general protocol were recognised. Projects that will be developed as part of the post-meeting activities were identified: a conceptual paper dealing with how to develop sampling designs for studies of plant-herbivore interactions, and a more specific protocol paper, which will develop a standard set of measurements so that data from different places can be related to each other. As a parallel effort, a synthesis of studies investigating the impacts of herbivory in the Arctic will be conducted.

Parallel to these projects, a new soil working group was created within the HN (see below) to review the effects of herbivory on soils and to develop a soil protocol to evaluate the effects of herbivory on soils. Moving these projects further will also be complemented by conducting a synthesis of herbivory studies in the Arctic. The development of the protocols will also strengthen links with ongoing monitoring programs, specifically with the Terrestrial Monitoring Programme of CBMP; some members of the HN will follow up closer with some of the Expert Groups of CBMP Terrestrial.

Common herbivory protocol

Overall, there was a broad agreement among the side meeting and session participants on the need of collaborative efforts to address herbivory questions across different sites and at different spatial scales, and thus the necessity of implementing common protocols to monitor herbivory and its impacts on tundra ecosystems. The two main overarching research questions that were formulated for the HN in the previous ASSW meeting will also be guiding the development of the protocol:

- **QUESTION 1.** How do herbivores affect tundra vegetation? What causes temporal and spatial variation in the outcomes of plant-herbivore interactions?
- **QUESTION 2.** How do herbivores modulate the responses of tundra vegetation to environmental change?

Based on these research questions, there is consensus that we need to combine long-term observations and a well-replicated experimental approach, over several locations throughout the Arctic (with potential expansion to alpine sites). Ideally, a first draft of a general protocol should be ready for implementation in summer 2015, at least for the monitoring (observational) part, but should also include some initial guidelines for experimental manipulations that need to be checked in the field before general recommendation. This initiative will be led by Guillermo Bueno, with the support of Kari Anne Bråthen and other members of the HN steering group.

The development of the protocol requires facing some critical challenges, like selecting the common scales at which measurements can be made to capture the main processes involved, or defining ‘common currencies’ for plant-herbivore interactions, so that measures on the impact of herbivory are comparable for different groups of herbivores and plants. This highlights the need for developing a theoretical justification for the implementation of the protocol within an ecological sampling framework (led by Virve Ravolainen and Eeva Soininen) and a synthesis of existing studies on herbivory in the Arctic (led by Isabel C Barrio).

Establishment of a soil working group within the Herbivory Network

Soils are a key element of tundra ecosystems, limiting the survival, growth and reproduction of plants. Herbivores can have a large spatial and temporal effect on soils (i.e. trampling, faeces deposition or biomass and litter removal by grazing), which can in turn alter ecosystem development, community composition and plant fitness. Despite their potential importance, the effects of herbivory on tundra soils are still largely unknown. Therefore, two main

activities have been planned for a newly created soil working group within the HN: 1) a review of the effect of herbivores and herbivory on soils, and 2) an effort to develop a soil protocol incorporating soil analyses and measurements that could be implemented as an add-on to the herbivory protocol. This initiative will be led by Maria Väisänen, Maria Tuomi and Guillermo Bueno.

Appendices

- Appendix 1. List of participants
- Appendix 2. PowerPoint slides on the aim and outcomes of the workshop

Appendix 1. List of side-meeting participants

Participant	country	affiliation	email	stage
Linda Ársælsdóttir	IS	University of Iceland	lia9@hi.is	EC*
Ashley Asmus	US	University of Texas (Arlington)	ashley.asmus@gmail.com	EC
Isabel C Barrio	CA	University of Alberta	icbarrio@gmail.com	EC*
Guillermo Bueno	CA	University of Alberta	cgbuenog@gmail.com	EC*
Dorothee Ehrich	NO	University of Tromsø	dorothee.ehrich@uit.no	S
Bruce Forbes	FI	University of Lapland	bruce.forbes@ulapland.fi	S
Katrine Hoset	FI	University of Turku	kathos@utu.fi	EC
Ingibjörg Svala Jónsdóttir	IS	University of Iceland	isj@hi.is	S
Edwin Liebig	IS	University of Iceland	ecl1@hi.is	EC*
Martin Moersdorf	IS	University of Iceland	mam28@hi.is	EC*
Isla Myers-Smith	UK	University of Edinburgh	isla.myers-smith@ed.ac.uk	S
Åshild Ø Pedersen	NO	Norwegian Polar Institute	aashild.pedersen@npolar.no	S
Virve Ravolainen	NO	Norwegian Polar Institute	virve.ravolainen@uit.no	S
Eeva Soininen	NO	University of Tromsø	eeva.soininen@uit.no	EC
Maria Tuomi	FI	University of Turku	maria.tuomi@utu.fi	EC
Maria Väisänen	FI	University of Lapland	maria.vaisanen@ulapland.fi	EC

NOTE: S: senior researcher, EC: early career researcher, * supported by TWG IASC early career grants

Appendix 3. PowerPoint slides