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Program

• Tuesday 31.1.

1st day of Oikos Finland 2017 Conference in the main building of University of Helsinki (Fabianinkatu 33, 2nd floor, Sali 1)

9.00 – 9.15 Welcoming words & Oikos prize

9.15 – 10.15 **Plenary: Eline Lorenzen** (University of Copenhagen, Denmark), *Biogeographic insights from past and present megafauna DNA*. Chair: Kristjan Niitepöld

10.15 – 10.45 Coffee

10.45 – 12.15 Parallel sessions:

Applied Ecology (3rd floor, Sali 13) Chair: Otso Huitu

10.45 – 11.00 Jarno Vanhatalo (University of Helsinki), *Modeling the spatial distribution of larval fish abundance provides essential information for management*

11.00 – 11.15 Johanna Eklund (University of Helsinki), *Contrasting spatial and temporal trends of protected area effectiveness in mitigating deforestation in Madagascar*

11.15 – 11.30 Raisa Mäkipää (Natural Resources Institute Finland), *Forest nitrogen cycling revisited - tight linkages between decomposition, fungal community and asymbiotic nitrogen fixation*

11.30 – 11.45 Aigi Margus (University of Jyväskylä), *Multiple stressors: can glyphosate modify response to an insecticide?*

11.45 – 12.00 María Triviño (University of Jyväskylä), *Optimizing management to enhance multifunctionality in a boreal forest landscape*

12.00 – 12.15 Andrea Santangeli (LUOMUS), *The benefits of making ecology more applied*

Behavioral Ecology (Sali 1) Chair: Kai Lindström

10.45 – 11.00 Carita Lindstedt-Kareksela (University of Jyväskylä), *Sex-linked deception in costly cooperative antipredator defence in social pinesawfly*

11.00 – 11.15 Emily Burdfield-Steel (University of Jyväskylä), *Safety in numbers? How colour morph frequency affects predation risk in an aposematic moth*

11.15 – 11.30 Luisa Woestmann (University of Helsinki), *Live fast, die young? How females adjust their reproductive strategy in case of poor conditions*

11.30 – 11.45 Tuuli-Marjaana Koski (University of Turku), *Insect herbivory may cause changes in visual properties of leaves and affect the background matching of the herbivore to avian predators*

11.45 – 12.00 Gautier Baudry (University of Oulu), *Female sexual signaling in a capital breeder*

12.00 – 12.15 Jukka Kekäläinen (University of Eastern Finland), *Paternally-mediated non-genetic inheritance shapes the phenotype and performance of the offspring in whitefish*

12.15 – 13.30 Lunch

13.30 – 14.30 **Plenary (Sali 1): Janne Kotiaho** (University of Jyväskylä, Finland), *Framework for assessing and reversing ecosystem degradation*. Chair: Johanna Eklund

14.30 – 16.00 Coffee & Post

er session in the halls of 1st and 2nd floors of University main Building

16.00 – 17.30 Parallel sessions:

Forests in the era of bioeconomy (Sali 1) Chair: Mikko Mönkkönen

16.00 – 16.15 Olli Tahvonen (University of Helsinki), *On the choice between continuous cover vs. clearcut forestry*

16.15 – 16.30 Anu Akujärvi (Finnish Environment Institute), *Spatial analysis of ecosystem services in boreal forests: Integrated approaches for quantifying biodiversity, carbon and nutrient pools*

16.30 – 16.45 Lauri Valsta (University of Helsinki), *Experiences in monetizing forest ecosystem service values related to biodiversity and climate change*

16.45 – 17.00 Raisa Mäkipää (Natural Resources Institute Finland), *Continuum of dead wood in managed forests and predictions of fungal diversity*

17.00 – 17.15 Kyle Eyvindson (University of Jyväskylä), *Mitigating forest biodiversity and ecosystem service losses in the era of bio-based economy*

17.15 – 17.30 Heli Peltola (University of Eastern Finland), *Scenario analyses for the effects of harvesting intensity on development of forest resources, timber supply, carbon balance and biodiversity of Finnish forestry*

Community ecology & Species interactions (Note the different building, Porthania, yliopistonkatu 3, 1st floor, PIII) Chair: Annu Ruotsalainen

16.00 – 16.15 Nerea Abrego (Norwegian University of Science and Technology), *Changes in biotic interaction determine hump-shaped species richness patterns in ECM communities*

16.15 – 16.30 Panu Halme (University of Jyväskylä), *Variation in dispersal-related traits of wood-inhabiting fungi – implications for dispersal*

16.30 – 16.45 Heidi Björklund (University of Helsinki), *Intraguild predation and competition impacts on a subordinate predator*

16.45 – 17.00 Steve Parratt (University of Helsinki), *Do spatial or genetic factors determine hyperparasite-pathogen infection dynamics?*

17.00 – 17.15 Kalle Ruokolainen (University of Turku), *Can we measure the importance of environmental variables controlling species abundances?*

17.15 – 17.30 Henni Yläne (University of Oulu), *Depicting grazer control over tundra carbon storage under the present and a warmer climate*

19.00 Conference dinner at Hotel Arthur (Vuorikatu 19)

• **Wednesday 1.2.**

2nd day of Oikos Finland 2017 Conference (Fabianinkatu 33, Sali 1)

9.00 – 9.30 Welcome & announcements

9.30 – 10.30 **Plenary: Maarja Öpik** (Tartu University, Estonia), *Species pools and dark diversity of arbuscular mycorrhizal fungi*. Chair: Anne Duploy

10.30 – 11.00 Coffee

11.00 – 12.30 Parallel sessions:

Aquatic populations, communities and ecosystems in the Anthropocene (Sali 1) Chair: Jani Heino

11.00 – 11.15 Jaakko Erkinaro (Natural Resources Institute Finland), *Biodiversity of a large population complex of Atlantic salmon in the River Teno*

11.15 – 11.30 Janne Alahuhta (University of Oulu), *A comparative analysis of the species richness and taxonomic distinctness of lake macrophytes in four regions: similarities, differences and randomness along environmental gradients*

11.30 – 11.45 Ivan Rodil (Tvärminne Zoological Station, UH), *Differential roles of dispersal mode and habitat specialization on the metacommunity structure of shallow beaches*

11.45 – 12.00 Fiia Haavisto (University of Turku), *Predator intimidation effects on macroalga-herbivore interaction in the Baltic Sea littoral*

12.00 – 12.15 Sami Taipale (University of Jyväskylä), *Does terrestrial organic matter benefit freshwater food webs?*

Biodiversity (Note the different building, Porthania, yliopistonkatu 3, 1st floor, PIII) Chair: Craig Primmer

11.00 – 11.15 Skúli Skúlason (Hólar University College, Iceland), *Resource polymorphism in Arctic charr: an integrative perspective*

11.15 – 11.30 Annika Vilmi (Finnish Environment Institute & University of Oulu), *Ecological uniqueness of stream and lake diatom communities shows different macroecological patterns*

11.30 – 11.45 Gabriel Moulatlet (University of Turku), *Mapping the association between local scale floristic composition and hydrological conditions in Amazonia*

11.45 – 12.00 Eric Le Tortorec (University of Jyväskylä), *Using change trajectories to study the impacts of multi-annual habitat loss on fledgling success in an old forest specialist bird*

12.00 – 12.15 Jacqueline Moustakas-Verho (University of Helsinki), *Is high complexity unbearable?*

12.15 – 12.30 Otso Ovaskainen (University of Helsinki), *How to make more out of community data? A conceptual framework and its implementation as models and software*

12.30 – 13.30 Lunch

13.30 – 14.30 **Plenary (Sali 1): Virpi Lummaa** (University of Turku, Finland), *Evolutionary ecology of historical Finnish people: how famines, disease and cold weather shaped individual life histories*. Chair: Abhilash Nair

14.30 – 16.00 Panel discussion (Sali 1) & coffee

16.00 – 17.00 Parallel sessions

Evolutionary Ecology (Sali 1) Chair: Leena Lindström

16.00 – 16.15 Jostein Gohli (University of Helsinki), *Explaining biogeographic range size and measuring its effect on species diversification in bark beetles*

16.15 – 16.30 Päivi Sirkiä (Finnish Museum of Natural History), *Habitat specific build-up of temporal isolation in a young hybrid zone*

16.30 – 16.45 Anna Kuparinen (University of Helsinki), *Genetic architecture of age at maturity can generate divergent and disruptive harvest-induced evolution*

16.45 – 17.00 Anssi Karvonen (University of Jyväskylä), *Effect of low environmental antibiotic concentrations on parasite co-infections*

Population Ecology (3rd floor, Sali 13) Chair: Kristjan Niitepöld & Otso Ovaskainen

16.00 – 16.15 Saskya Van Nouhuys (University of Helsinki), *Decline in geographic genetic structure with increasing trophic level for interacting species in a fragmented landscape*

16.15 – 16.30 Otso Huitu (Natural Resources Institute Finland), *Interactions between food resources and infection in boreal vole populations during winter*

16.30 – 16.45 Jenni Santaharju & Terhi Honkola (University of Helsinki & University of Turku), *Applying population and landscape genetics to study the Finnish dialects*

16.45 – 17.00 Jeffrey Hutchings (Dalhousie University, Canada), *Allee Effects, Life History, and Recovery in Fishes*

17.00 – 18.00 Oikos Finland organization meeting

Plenary Sessions

· Tuesday 31.1.

09:30 Biogeographic insights from past and present megafauna DNA (keynote)

Eline Lorenzen (University of Copenhagen, Denmark)

Next-generation DNA sequencing has revolutionized the way we can study evolutionary and ecological processes using genomic data. In this talk, I will show how genomic data can be used in an evolutionary and ecological context, to understand the past and present diversity, distribution, and dynamics of megafauna (large mammal) species and communities. I will discuss how DNA retrieved from ancient material including the bones, teeth and gut content of Late Pleistocene megafauna can be used to infer the past ecology and population dynamics of extinct species, and demonstrate how DNA extracted from sediments can be used to reconstruct the palaeoenvironments once inhabited by these Ice Age giants. Furthermore, using genome-wide data from the polar bear, I will demonstrate how population genomics has been used to estimate the age of the species, reconstruct the joint demographic history of polar bear and brown bear, and identify candidate genes under positive selection in the polar bear lineage that have enabled the species to survive the extreme conditions of life in the High Arctic.

13:30 Framework for assessing and reversing ecosystem degradation

Janne Kotiaho (University of Jyväskylä, Finland)

In this contribution, I will derive a procedure that answers the question: how can we achieve the CBD Aichi target on restoration of at least 15% of degraded habitats by 2020 in a way that is scientifically valid. I will argue that from an ecological perspective, it is necessary to recognize that ecosystem degradation or improvement has a minimum of two components: the extent of area that has been degraded or restored and the magnitude of the degradation, or its counterpart improvement, at any given location. Indeed, from an ecological perspective restoration cannot logically be about the area alone. Second, I will introduce a pragmatic minimalist decision support and assessment framework that will allow prioritization of cost efficient restoration measures across ecosystems. Finally, by showing results from a national restoration prioritization work (ELITE-project), I will conclude that to obtain a scientifically justified 15% reduction in the degradation of ecosystems we need to apply heavy restoration measures across very large areas in extremely short time, simultaneously compensating for ongoing degradation elsewhere. It appears that the 15% target may prove unrealistically challenging and impossible to ever be met. It is implicit in the target of reversing 15% of ecosystem degradation by restoration that further degradation is taken into account in the balance. Therefore, mankind can be proud if we can achieve even a modest fraction of the current 15% restoration target, because then the global trend of continuing habitat loss would already be stopped and reversed.

For details see the two documents from the below links:

Elinympäristöjen tilan edistäminen (ELITE) Suomessa: <https://helda.helsinki.fi/handle/10138/156982>

Framework for assessing and reversing degradation: <https://julkaisut.valtioneuvosto.fi/handle/10024/74862>

· **Wednesday 1.2.**

09:30 Species pools and dark diversity of arbuscular mycorrhizal fungi

Maarja Öpik (Tartu University, Estonia)

Understanding about the global biodiversity of Glomeromycotina (arbuscular mycorrhizal fungi, AMF) and its patterns has considerably improved in recent years. Evidence on low global scale endemism of AMF and environmental and spatial factors shaping the diversity patterns at local scale raise further questions on the roles of factors that may influence AMF communities at different spatial scales: rate of speciation, dispersal properties, abiotic and biotic filtering. Namely, do AMF have species pools sets of species adapted to specific conditions? If they do, what determines the species pool size? What is the relationship of observed diversity and potential available diversity (species pool) and what determines the size of dark (potential, but missing) diversity? In my presentation I intend to shed light on the recently gained understanding regarding these questions and illustrate how consideration of species pools and dark diversity is informative when studying communities of AMF

13.00 Evolutionary ecology of historical Finnish people: how famines, disease and cold weather shaped individual life histories

Virpi Lummaa (University of Turku, Finland)

Ecological conditions experienced by individuals particularly during their early life not only influence their growth and development, but can also be related to the survival and reproductive success of the same individuals in adulthood, as well as to the growth and reproduction of their offspring. These patterns can result from selective disappearance of individuals with only the most robust ones surviving to adulthood; from predictive adaptive responses whereby poor early-life conditions induce physiological changes that maximize fitness in similar environments in adulthood but involve costs when early and later environmental conditions mis-match; or from silver-spoon effects where poor early conditions constrain development and exacerbate the effects of poor nutrition later in life. I explore how variation in early-life ecological conditions, measured by between-cohort differences in food access, disease exposure, climatic conditions or infant mortality, are related to reproductive success and lifespan of historical Finnish people. I further discuss how such effects may differ between the sexes or socio-economic classes, and for cohorts having to cope with poor conditions such as famines later in their life. The findings are discussed against the dramatic changes in environmental conditions, reproduction and lifespan over the past 150 years.

Applied Ecology Session

Chair: Otso Huitu

· **Tuesday 31.1.**

11:00 Modeling the spatial distribution of larval fish abundance provides essential information for management

Jarno Vanhatalo (University of Helsinki), Meri Kallasvuo (Natural Resources Institute Finland),
Lari Veneranta (Natural Resources Institute Finland)

Productive fisheries are strongly linked to the ecological state of the essential fish habitats. We will present a methodology to assess the most important reproduction habitats of fish by using larval survey data and Bayesian species distribution models that predict the spatial distribution and abundance of fish larvae. As a case study we examine the reproduction areas of four commercially and ecologically important fish species (perch, pike perch, smelt, herring) in the coastal zone of the northern Baltic Sea. Moreover, Our study demonstrates that the production of fish stocks can be concentrated to an extremely limited area compared to the entire suitable production area. The area suitable for larval production varied from 3.7% to 99.8% between species, but the smallest area responsible for 80% of the cumulative larval production was two to five times more limited, varying from 1.4% to 52.9% between species. Hence, instead of the traditional approach of modeling only habitat suitability for fish production, marine spatial planning and management should take into account the areal production potential. Moreover, the developed methodology enables linking of the total production potential across the whole distribution area to fisheries stock assessment and management.

11:15 Contrasting spatial and temporal trends of protected area effectiveness in mitigating deforestation in Madagascar

Johanna Eklund (University of Helsinki), F. Guillaume Blanchet (McMaster University),
Johannes Nyman (University of Helsinki), Ricardo Rocha (University of Lisbon), Tarmo
Virtanen (University of Helsinki), Mar Cabeza (University of Helsinki)

Networks of protected areas (PAs) form the backbone for biodiversity conservation worldwide. The effectiveness of protected areas has been studied and it has been shown that confounding factors, such as remoteness and accessibility, correlated with both presence of protection and extractive behaviors, affect the outcomes. We investigated the effectiveness of Madagascar's PA network in decreasing deforestation pressures, using a novel counterfactual methodology, accounting for distance to roads, rivers, major cities and altitude, slope and annual rainfall. The assessment was independently conducted for two different time periods, 1990-2000 and 2000-2010, and for Madagascar's three major forest types. We found that PAs were effective to some extent in reducing deforestation and that some of this decrease can be attributed to the presence of PAs, not just to the confounding factors rendering the land assigned for protection less likely to be deforested. We found differences in PA effectiveness between the two time periods, and in general lower deforestation in the later time period has meant that the PAs have less pressures to resist. However, in the spiny forest, even if deforestation had overall diminished, the pressure on reference areas used to compare PAs seemed to have increased showing that PAs have indeed a mitigation effect and thus increased in effectiveness in the second time period. Our study highlights the alarming trend of what happens once enough forest has been lost in easily accessible areas and the pressures starts to spread to also more remote areas and lands comparable to PAs (remote and inaccessible).

11:30 Forest nitrogen cycling revisited - tight linkages between decomposition, fungal community and asymbiotic nitrogen fixation

Raisa Mäkipää (Natural Resources Institute Finland), Katja Rinne-Garmston (Natural Resources Institute Finland), Aino Smolander (Natural Resources Institute Finland), Hannu Fritze (Natural Resources Institute Finland), Erik Hobbie (University of New Hampshire), Janet Chen (International Atomic Energy Agency), Tero Tuomivirta (Natural Resources Institute Finland), Krista Peltoniemi (Natural Resources Institute Finland)

In boreal forests, nitrogen availability is a major limiting factor for growth of trees and other plant species and it is also a driver of the microbial activity. Decomposition of dead wood, which is controlled primarily by fungi, contributes substantially to the long-lived forest carbon (C) pool and has a significant role in forest nitrogen (N) cycling. Because of the very high C:N ratios in decaying wood, the rates of N cycling processes and fungi-driven decomposition are tightly linked. External sources of N may be vital in establishing and maintaining high decomposition rates, due to the importance of N in production of enzymes and fungal material. Wood N content has been found to increase during the decay process; however, the sources of this external N remain unclear. To examine N dynamics at various stages of decomposition, we combined a high variety of analytical methods on Norway spruce logs: wood nitrogen isotope composition ($\delta^{15}\text{N}$), wood N content (N%), radiocarbon dating, fungal composition and fixation rate of atmospheric N_2 into wood by bacteria. For N_2 fixation rate we also determined its dependency on ambient temperature and decay class, when estimating annual N_2 fixation rates for our study site. N_2 fixation was observed to have a major role in increasing wood N content during decay. For the most decayed wood it accounted for 60% of the total N accumulation. The calculated annual fixation rate was 85 g N/ha/a. Our $\delta^{15}\text{N}$ model describing the sources of external N, statistical analysis and the fungal DNA composition of decayed wood suggest that other sources of external N accumulating in wood were soil foraging wood-decay fungi and mycorrhizal fungi. Our study improves knowledge of the temporal dynamics of N accumulation in wood with advancing wood decay, the potential sources of external N and their relative significance. All of these factors are important for nitrogen as well as carbon models dealing with ecosystem responses to climate change.

11:45 Multiple stressors: can glyphosate modify response to an insecticide?

Aigi Margus, Miia Rainio, Leena Lindström

Organisms live in complex multivariate environment, especially in agricultural systems, where individuals can be exposed to multiple human induced xenobiotics simultaneously. This has led to growing interest in multiple stressor research, because the single variable based research can lead to an under- or overestimation in a multivariate environment. Moreover, the interactions between two stressors are more likely to have interactive rather than additive effects. In current study we investigate the different mechanisms by which the first stressor, a glyphosate exposure can modulate responses to the second stressor, an organophosphate insecticide. First, glyphosate belongs to an organophosphate chemical class, like majority of commonly used insecticides. Secondly, herbicides can induce changes in plant defence toxins which in turn can increase the insects' metabolic detoxification. Third, so far too little attention has been paid to the interactive effects of so called safe chemicals like glyphosate that can potentially have jointly larger effect than otherwise predicted. The objective of this study is to investigate whether glyphosate exposure via food intake affects the gene expression of the target-site (acetylcholinesterase genes), metabolic site (GST and CYP gene) and oxidative stress biomarkers (GST, G6PDH, GR, GP, totGSH, GSH: GSSG, CAT, SOD) in an invasive pest *Leptinotarsa decemlineata*. We found that glyphosate has no single or interactive effect together with insecticide on the survival. However, glyphosate can inhibit acetylcholinesterase gene expression, which is also the target of organophosphate and carbamate insecticides. Further more oxidative stress biomarker (GP, GR, CAT) scores were lowest when exposed to both stressors. The rest of the oxidative stress biomarkers were not affected by the glyphosate or insecticide exposure. Overall, these results indicate that glyphosate exposure can increase the susceptibility to insecticide stress.

12:00

Optimizing management to enhance multifunctionality in a boreal forest landscape

María Triviño (University of Jyväskylä), Tähti Pohjanmies (University of Jyväskylä), Adriano Mazziotta (University of Stockholm), Artti Juutinen (University of Oulu), Dmitry Podkopaev (Polish Academy of Sciences), Eric Le Tortorec (University of Jyväskylä), Mikko Mönkkönen (University of Jyväskylä)

The boreal biome, representing approximately one third of remaining global forests, provides a number of crucial ecosystem services. A particular challenge in forests is to reconcile demand for increased timber production with provisioning of other ecosystem services and biodiversity. However, there is still little knowledge about how forest management could help solve this challenge. Here, we applied seven alternative forest management regimes using a forest growth simulator in a large boreal forest production landscape. First, we estimated the potential of the landscape to provide harvest revenues, store carbon and maintain biodiversity. Then, we applied multiobjective optimization to identify trade-offs between these three objectives, and to identify the optimal combination of forest management regimes to achieve these objectives. Our results show that no forest management regime alone is able to maximize timber revenues, carbon storage and biodiversity individually or simultaneously, and that a combination of different regimes is needed to resolve the conflicts among these objectives. We conclude that it is possible to reduce the trade-offs between different objectives by applying diversified forest management planning at the boreal landscape-level and that we need to give up the all-encompassing objective of very intensive timber production, which is prevailing particularly in Fennoscandian countries.

12:15

The benefits of making ecology more applied

Andrea Santangeli (Finnish Museum of Natural History, LUOMUS), William J. Sutherland (University of Cambridge)

In conservation, as in most other subjects, there is a division of expenditure into problem identification, solution testing and practice. However, research concentrates on problem identification rather than solution testing. We calculate the return on the investment of research (a PhD thesis) examining the effectiveness of conservation interventions for birds of prey in three European countries. We show that the economic return from investing in a PhD thesis could be substantial, in the order of hundreds of thousands euros over ten years or a return on investment of between 292 and 326% over that period. We derived the values of return on investment by first setting a common biological target (the total number of raptor fledglings produced per year). We then compared overall costs in achieving such target via the wide implementation of the results from the thesis (i.e. allocating resources to the most effective intervention) versus a business as usual scenario. We identify other theses that also show considerable benefits in improving effectiveness. We suggest that further research examining effectiveness would be cost-effective in improving practice.

Behavioral Ecology Session

Chair: Kai Lindström

· **Tuesday 31.1.**

11:00 **Sex-linked deception in costly cooperative antipredator defence in social pinesawfly**
Carita Lindstedt-Kareksela (JYU)

The evolution of costly cooperative behaviour remains one of the great evolutionary puzzles. One of the key challenges is to determine the extent to which individuals vary in their contribution to a cooperative act, and whether this variation simply reflects their ability to sustain the associated costs, or is an act of deception. Furthermore, for many organisms, the costs and benefits of cooperation are likely to vary with changes in ecological and social conditions. We investigated these less studied aspects with haplodiploid social *Diprion pini* pine sawfly larvae that perform defensive group-rearing and regurgitation behaviour. The benefit of this system is that there is natural variation in the benefits and costs of cooperation, and in the relatedness among cooperating individuals. We can also manipulate these parameters experimentally. A higher frequency of defending individuals, with greater toxicity of defensive secretions should provide better protection against predators as each of these characters have been shown to enhance a survival against predators. However, if contributing to toxic defences for the common defence against predators is costly, it may sometimes benefits the individual to forgo their personal contribution and instead to exploit the common protection on offer. We tested investment to defensive responses and its correlated fitness effects under various conditions by manipulating diet, attack intensity and social environment. Investing to defensive behaviour was costly decreasing growth rate and immunology and future defensive capacity. In sexually produced clutches, female larvae were always more likely to defend and produced higher quantities of defence fluid than male larvae indicating potentially parasitic relationship between males and females in cooperative defence. In asexually produced all-male clutches male larvae allocated more to defensive behaviour. Thus, males are more likely to exploit their sisters in costly common defence.

11:15 **Safety in numbers? How colour morph frequency affects predation risk in an aposematic moth**
Emily Burdfield-Steel (University of Jyväskylä), Swanne Gordon (University of Jyväskylä),
Johanna Mappes (University of Jyväskylä)

Aposematic organisms protect themselves from predators through the combination of a primary warning signal and a secondary defense. It is expected that predators will learn to avoid a warning signal faster when they encounter it frequently. However many aposematic species still show variation in their warning signals. To advertise its chemical defenses, the wood tiger moth has two discrete male colour morphs in Finland, as well as sexual dimorphism. Previous work has shown that these different colour morphs elicit different levels of aversion in natural bird predators, so why then do weaker signals persist? Using wild-caught great tits (*Parus major*), we investigate the effect of the relative frequency of the 3 morphs on predator behavior to determine 1) if morphs benefit from positive frequency dependence and 2) if frequency dependent effects are morph-specific. We found that the white morph benefited from positive frequency dependence as white moths were attacked less when they were the most common morph.

11:30 Live fast, die young? How females adjust their reproductive strategy in case of poor conditions

Luisa Woestmann (University of Helsinki), Marjo Saastamoinen (University of Helsinki)

Resource-allocation trade-offs assume that a fraction of acquired reserves is allocated to somatic maintenance and growth, while the rest is allocated to maturation and reproduction. Many species have evolved flexible reproductive strategies, which allow them to adjust their investment in different components of reproductive success in response to the environmental condition they experience. Environmental factors as temperature, quantity and/or quality of resources, or risk of infection can greatly influence female reproductive investment in her offspring – the direction of this effect however has been shown to differ. Female reproductive success and fitness might be negatively affected by severe shortage of food or infection risk. However, under a more moderate stress event females may be able to speed up reproduction to compensate for a shortened lifespan (terminal investment). We investigated the effect of poor environmental conditions (food deprivation and bacterial infection) during the reproductive stage in the Glanville fritillary butterfly (*Melitaea cinxia*) on male and female fitness traits (e.g. oviposition speed, reproductive success, average egg weight and hatching success). Food deprivation of mothers induced faster oviposition strategy but still resulted in reduced lifetime reproductive success. Stressed fathers on the other hand sired more offspring, possibly due to higher investment into their spermatophores. An infection induced by bacterial feeding suggests a similar change of oviposition strategy, however, females were able to keep up in terms of lifetime reproductive success. In both scenarios, poor conditions resulted in an investment in offspring quality rather than quantity

11:45 Insect herbivory may cause changes in visual properties of leaves and affect the background matching of the herbivore to avian predators

Tuuli-Marjaana Koski (University of Turku), Carita Lindstedt (University of Jyväskylä), Tero Klemola (University of Turku), Jolyon Troscianko (University of Exeter), Elina Mäntylä (University of Turku), Esa Tyystjärvi (University of Turku), Martin Stevens (University of Exeter), Marjo Helander (University of Turku), Toni Laaksonen (University of Turku)

Cry for help theory expects that plants decrease insect damage by attracting predators with chemical or visual cues. Visual cues may involve changes in photosynthetic activity and the reflectance of plant leaves, and there is some evidence that insectivorous birds may use these changes as foraging cues. However, the changes in the visual properties of leaves have not been properly quantified and it is not known how birds see these changes. In addition, we hypothesise that these changes may disrupt the background matching of the herbivore. To study these questions, we manipulated the level of herbivory in silver birch trees (*Betula pendula*) with autumnal moth (*Epirrita autumnata*) larvae. We measured chlorophyll content, photosynthetic activity, as well as colour, luminance (lightness), contrast (luminance SD/luminance mean) and transparency of the leaves. Avian visual models were used to test the conspicuousness of these changes to blue tits (*Cyanistes caeruleus*) and whether the changes affect the camouflage of the larvae, that feed on the leaves. The leaves of herbivore-damaged trees had a decreased chlorophyll concentration, increased contrast and shift in colour to longer wavelengths compared to leaves of non-damaged trees. However, these changes may be subtle cues to birds. In addition, although the larvae were less conspicuous when on the leaves of herbivore-damaged trees, birds can likely easily discriminate larvae against leaves of both control and herbivore-damaged trees. Our results indicate that herbivores may be adapted to changes in the food plant, and that predators as well as food plants likely affect the cryptic coloration of the herbivore.

12:00

Female sexual signaling in a capital breeder

Gautier Baudry (University of Oulu), Juhani Hopkins (University of Oulu), Phillip Watts (University of Oulu), Arja Kaitala (University of Oulu)

Ornaments are sexually selected traits used as signals to attract mates. The development and maintenance of ornaments impose supplementary costs on individuals. These costs are well studied on males but it is not well understood how these affect females. In species where females actively use their ornament to attract males, the number of attracted males depends on female signaling effort but the costs of over-signaling are predicted to be the main constraint on signaling pattern. If male density is unknown to females, the only indication about male density for females is the amount of time spent signaling unsuccessfully. In such condition, to attract males without over-signaling, females are predicted to start signaling at low intensity and short duration, and increase their signaling effort until mating. This may be especially true in capital breeders as their energy limitation may act as a pressure to avoid waste of energy. The common glow-worm *Lampyris noctiluca*, a nocturnal capital breeder, provides an excellent model for the study of female sexual signaling. In this species, wingless females use their glow as a sexual signal to attract flying males. We predicted that female glowing effort increases with time spent signaling unsuccessfully. To test this, female glowing intensity and duration were monitored for five days and in two different light treatments. Against expectations, we found that the signaling duration of virgin females significantly decreased with time, while signaling intensity remained the same. Our results suggest that resource limitations may pressure females to signal as much as possible even at the beginning of the mating period if waiting is more costly than signaling.

12:15

Paternally-mediated non-genetic inheritance shapes the phenotype and performance of the offspring in whitefish

Jukka Kekäläinen (University of Eastern Finland)

Inheritable information transfer between generations has traditionally been assumed to occur only via genetic factors. More recent evidence has revealed that the contribution of the parents to the phenotype of their offspring is not restricted to genes alone. Accordingly, female-mediated non-genetic effects (maternal effects) are now widely recognized. However, paternal effects have been assumed to play no role in heritability or evolution. Against this view rapidly accumulating evidence suggest that paternal effects may be widespread, but so far their ecological and evolutionary consequences have remained poorly understood. We studied paternally-mediated (non-genetic) effects and the relative importance of genetic and non-genetic inheritance mechanisms in whitefish (*Coregonus lavaretus*). In order to illuminate these weakly known mechanisms, we manipulated the pre-fertilization temperature of the sperm of 10 males by splitting their ejaculates into two temperature treatments (3.5°C and 6.5°C) for 15 h. Then we conducted a full factorial breeding design where the eggs of same five (standard) females were fertilized with the similar volume of sperm from all 10 males (within both sperm treatments). Our results show that sperm treatment did not affect on sperm motility, fertilization success or embryo mortality, indicating that sperm treatments did not damage sperm cells. However, sperm treatments had differential effect on offspring body size at hatching and their swimming performance (both higher for 3.5°C treated sperm). Maternal effects accounted largest proportion of the variance in measured offspring traits, which is not surprising given that maternal effect typically dominate offspring early development. However, sperm treatment (non-genetic effect) accounted second largest proportion of phenotypic variance, which indicates that paternal effects are far from trivial and thus can have many important ecological and evolutionary consequences.

Forests in the era of Bioeconomy Session

Chair: Mikko Mönkkönen

· Tuesday 31.1.

16:00 On the choice between continuous cover vs. clearcut forestry

Olli Tahvonen (University of Helsinki)

Optimization models on continuous cover forestry are complicated and are typically incompatible with rotation models. This dichotomy is theoretically unsatisfactory and makes the choice between clearcuts and continuous cover forestry vague. I present a simple theoretical setup and a detailed empirical application where the choice between optimal clearcut regime (or even-aged management) and optimal continuous cover regime (or uneven-aged management) is obtained directly as a part of the optimal solution.

The simplest form of the model is a continuous time optimal control problem (for stand without internal structure) where the horizon length (finite or infinite) determines the choice of the management regime. Continuous cover forestry is shown to be optimal if the present value of continuous sustainable harvesting income over an infinite horizon is higher than the clearcut revenue and the highest possible value of bare land. It is explained why—in contrast to Faustmann model—higher interest rate tends to increase rotation periods.

An empirical application includes an empirically estimated ecological growth model, variable and fixed harvesting costs and completely flexible optimization of harvest timing (thinning) in both continuous cover and clearcut forestry. Flexible harvest timing becomes essential when optimizing the transition from clearcut regimes toward continuous cover forestry. The empirical model is applied to Norway spruce and Norway spruce, Scots pine and birch mixture. The model is solved as a dynamic mixed-integer problem and applying a bi- and tri-levels optimization structure. Low or moderate site productivity, an interest rate above 2% and high artificial regeneration cost support the optimality of continuous cover forestry. The optimal choice between forest management regimes may depend on the initial stand state. Maximizing sustainable yield favors clearcuts. Finally the potential merits and problems of continuous cover forestry are discussed in the contexts of climate change, flood protection, biodiversity and various forest threats (wind, insects, fire).

16:15 Spatial analysis of ecosystem services in boreal forests: Integrated approaches for quantifying biodiversity, carbon and nutrient pools

Anu Akujärvi (Finnish Environment Institute, Natural Environment Centre, Helsinki / Department of Geosciences and Geography, University of Helsinki), Martin Forsius (Finnish Environment Institute, Natural Environment Centre, Helsinki), Maria Holmberg (Finnish Environment Institute, Natural Environment Centre, Helsinki), Laura Mononen (Finnish Environment Institute, Natural Environment Centre, Joensuu), Pekka Punttila (Finnish Environment Institute, Natural Environment Centre, Helsinki), Pekka Vanhala (Finnish Environment Institute, Natural Environment Centre, Helsinki), Petteri Vihervaara (Finnish Environment Institute, Natural Environment Centre, Helsinki)

Boreal forests provide a wide range of ecosystem services. Forests regulate greenhouse gas concentrations, the quality of drinking water, and provide wood and renewable energy for society through ecosystem processes such as carbon sequestration, water cycling and nutrient retention. Dead wood stabilizes the biogeochemical cycles of forest ecosystem and serves as a habitat for threatened species. The availability of these ecosystem services may be at risk because of pressures to intensify forestry. The use of forest bioenergy is projected to increase in Europe, with accompanying expansion in harvest volumes. Producing energy from forest harvest residues has been proposed as a means of mitigating the global climate change. However, forest management policies need to be evaluated based on their holistic effects on ecosystem sustainability. Here we present several case studies about the spatial analysis of ecosystem services and sustainability indicators in the boreal zone. The

demonstrated modelling frameworks utilise high-resolution spatial data on land cover and forest characteristics, citizen science, mass-balance calculations and dynamic modelling of soil carbon and nutrient cycles. The case studies encompass different spatial scales: habitats, catchments, regions and municipalities. They demonstrate trade-offs between ecosystem service indicators and the application of innovative observation and modelling techniques. The approaches allow seeking for optimal solutions between forest management objectives to support sustainable land use and climate policies.

16:30 Experiences in monetizing forest ecosystem service values related to biodiversity and climate change

Lauri Valsta (Department of Forest Sciences, University of Helsinki), Brent Matthies (Indufor)

Boreal forests provide significant ecosystem services locally and globally. We analyzed the importance of forest species composition for provisioning, regulating and supporting services. In our case studies, forest mixtures of conifers and broadleaved trees were considered. The ecosystem service approach entails important questions concerning valuation of services, additionality, leakage, and policy options. We used the Finnish policy environment as the basis of analysis.

We reviewed case studies that target forest management alternatives both at single stand level and at forest region level. Ecosystem services were assessed in terms of tree species composition, PES scheme, climate change mitigation values and commercial wood values. In general, our results indicate that the sum of ecosystem service values from mixed species forests often exceed those from pure, single stand forests. There are significant trade-offs among ecosystem service values, but a balanced management between providing for multiple objectives seems to provide a highest total value of services.

16:45 Continuum of dead wood in managed forests and predictions of fungal diversity

Raisa Mäkipää (Luke), Kari Härkönen (Luke), M.; Peltoniemi (Luke), K. Rinne (Luke), Olli Salminen (Luke), Artti Juutinen (Luke)

Habitat loss is globally a threat to biodiversity and in managed boreal forests a loss of dead wood habitats is the most common factor affecting species diversity. Wood inhabiting fungi are directly dependent on the amount and quality of dead wood. In this study, we analyzed the changes in the wood quality along the decay gradient, modelled habitat requirements of the wood-inhabiting fungi and dead wood continuum in boreal forests. Species habitat models and dead wood dynamics were also integrated into the forest simulator, which is applied for predictions of future dynamics of polypore diversity. The information on fungal habitat requirements integrated to forest simulation models facilitates the development of management practices that preserve fungal diversity in managed forests.

17:00 Mitigating forest biodiversity and ecosystem service losses in the era of bio-based economy

Kyle Eyvindson (University of Jyväskylä), Anna Repo (University of Jyväskylä), Mikko Mönkkönen (University of Jyväskylä)

Forests play a crucial role in the transition towards a bioeconomy by providing biomass to substitute for fossil-based materials and energy. Increasing forest harvest levels to meet the needs of the bioeconomy may conflict with biodiversity protection and ecosystem services provided by forests. Through an optimization framework, we examined trade-offs between increasing the extraction of timber resources, and the impacts on a biodiversity and non-wood ecosystem services, and investigated possibilities to reconcile trade-off with changes in forest management in 17 landscapes in boreal forests. A diverse range of alternative forest management regimes were used. The alternatives varied from set aside to continuous cover forestry and a range of management options to reflect potential applications of the current management recommendation. These include adjustments to the

number of thinning, the timing of final felling and the method of regeneration. Increasing forest harvest level to the maximum economically sustainable harvest had a negative effect on the habitat suitability index, bilberry yield, dead wood diversity and carbon storage. It resulted in a loss in variation among landscapes in their conservation capacity and the ability to provide ecosystem services. Multi-objective optimization results showed that combining different forest management regimes alleviated the negative effects of increasing harvest levels to biodiversity and non-wood ecosystem services. The results indicate that careful landscape level forest management planning is crucial to minimize the ecological costs of increasing harvest levels.

17:15 Scenario analyses for the effects of harvesting intensity on development of forest resources, timber supply, carbon balance and biodiversity of Finnish forestry

Heli Peltola (University of Eastern Finland), Lauri Mehtätalo (University of Eastern Finland), Antti Asikainen (Natural Resources Institute Finland), Jyrki Kangas (University of Eastern Finland), Heli Peltola (University of Eastern Finland)

Based on national scenario analyses, we study how the harvesting intensity together with even-flow harvesting requirements affect the development of forest resources, timber supply, carbon balance, and biodiversity indicators of Finnish forestry in nine 10-year simulation periods (90-year total simulation period) under the current climate. This study employed forest data from the National Forest Inventory of Finland (NFI11) and five even-flow harvesting scenarios where the annual harvest ranged from 40 to 100 million m³. Protected forests were excluded from calculations. The currently recommended thinning (basal area) and final felling (diameter at breast height) thresholds in Finland were multiplied by 0.9 to define the earliest possible time of uniform thinning and final felling and to allow greater flexibility in cuttings. Treatment schedules with postponed cuttings and a schedule with no cuttings were also simulated for each stand (sample plot). In forest regeneration, sub-xeric sites were sown and poorer sites were regenerated naturally for Scots pine. Planting Norway spruce was used to regenerate Mesic and herb-rich sites. Birch was planted only on the most fertile sites. Seedlings of different tree species were also born naturally on all sites. Artificial regeneration was assumed to result in 5% faster volume growth compared to naturally born seedlings. Our results show that the highest annual even-flow harvest level, which did not decrease the growing stock volume over the 90-year simulation period, was 73 million m³. Both the annual volume increment and the total carbon balance of forestry were the higher, the lower was the harvested volume. Volume increment increased for several decades when harvested volume was less than the current volume increment. Low harvested volume also improved the values of the biodiversity indicators.

Community, Ecology and Species Interaction Session

Chair: Annu Ruotsalainen

· **Tuesday 31.1.**

16:00 **Changes in biotic interaction determine hump-shaped species richness patterns in ECM communities**

Nerea Abrego (Norwegian University of Science and Technology), Huotari Tea (University of Helsinki), Roslin Tomas (Swedish University of Agricultural Sciences)

Natural communities consist of species interacting with each other. How the structure of species networks changes along environmental gradients is a topical area of research, fundamental to understanding community structure, ecological and evolutionary dynamics, and community response to environmental change. Where changes in network structure along latitudinal gradients has received increasing attention, little is known about whether the same patterns and mechanisms apply to local environmental gradients, and how they extend among interaction types. Here, we target a specific type of interactions: those between ectomycorrhizal fungi (ECM) and plants along an altitudinal gradient of the High Arctic. By applying a hierarchical joint species distribution model, we distinguish between species response to their joint environment and to each other, and quantify how ECM ECM and plant ECM interactions change with the increasingly stressful environmental conditions towards higher altitudes. We report a hump-shaped distribution of both ECM species richness and biotic interactions. Communities at both ends of the altitudinal gradient were characterized by less ECM taxa, stronger negative (competitive) interactions among these taxa, and higher specialization of ECM taxa for particular plant species. These findings suggest that processes proposed to account for latitudinal patterns in plant-ECM interactions will also shape communities at a local scale, and that mechanisms observed for plant-plant interactions will apply equally to ECM ECM interactions. Overall, our results identify biotic interactions as key drivers of local community structure across a wide range of interaction types and spatial scales.

16:15 **Variation in dispersal-related traits of wood-inhabiting fungi implications for dispersal**

Panu Halme (University of Jyväskylä), Anna Norberg (University of Helsinki), Otso Ovaskainen (University of Helsinki), Veera Norros (Finnish Environment Institute)

Species traits are the key to understanding why species occur when and where they do and how their populations are likely to respond to environmental changes. Dispersal-related traits are especially critical in species faced with habitat loss and fragmentation, such as wood-inhabiting fungi growing on large decaying logs. However, apart from spore size, dispersal-related traits of fungi are generally poorly known. We studied how two important determinants of passive airborne dispersal, ly the spore production rate and the typical height at which spores are released, are connected to other relevant traits in wood-inhabiting fungi. We found consistent between-species variation in both of the studied traits and their connection to other dispersal traits. Trait-based studies of fungal dispersal have a high potential in increasing our understanding for example about the effects of habitat fragmentation.

16:30 Intraguild predation and competition impacts on a subordinate predator

Heidi Björklund (UH, Finnish Museum of Natural History), Andrea Santangeli (UH, Finnish Museum of Natural History), F. Guillaume Blanchet (McMaster University, Canada), Otso Huitu (Natural Resources Institute Finland), Hannu Lehtoranta (The Finnish Forest Centre), Harto Lindén (Natural Resources Institute Finland), Valkama, Jari; UH, Finnish Museum of Natural History), Toni Laaksonen (University of Turku, Department of Biology)

Intraguild (IG) predation and interspecific competition may affect the settlement and success of species in their habitats. Using data on forest-dwelling hawks from Finland, we addressed the impact of an IG predator, the northern goshawk *Accipiter gentilis* (goshawk), on the breeding of an IG prey, the common buzzard *Buteo buteo*. We hypothesized that the subordinate common buzzard avoids breeding in the proximity of goshawks and that interspecific competitors, mainly *Strix* owls, may also disturb common buzzards by competing for nests and food. Our results show that common buzzards more frequently occupied territories with a low IG predation threat and with no interspecific competitors. We also observed that common buzzards avoided territories with high levels of grouse, the main food of goshawks, possibly due to a risk of IG predation since abundant grouse can attract goshawks. High levels of small rodents attracted interspecific competitors to common buzzard territories and created a situation where there was not only an abundance of food but also an abundance of competitors for the food. These results suggest interplay between top down and bottom up processes which influence the interactions between avian predator species. We conclude that the common buzzard needs to balance the risks of IG predation and interference competition with the availability of its own resources. The presence of other predators associated with high food levels may impede a subordinate predator taking full advantage of the available food. Based on our results, it appears that interspecific interactions with dominant predators have the potential to influence the distribution pattern of subordinate predators.

16:45 Do spatial or genetic factors determine hyperparasite-pathogen infection dynamics?

Steve Parratt (University of Helsinki), Benoit Barrés (Université de Lyon), Rachel Penczykowski (University of Wisconsin), Anna-Liisa Laine (University of Helsinki)

Coevolutionarily derived patterns of local adaptation among pathogen populations have the potential to generate variation in disease epidemiology, however studies of local adaptation in disease systems have mostly focused on interactions between competing pathogens or pathogens and their hosts. In nature, parasites and pathogens are also subject to attack by hyperparasitic natural enemies that can severely impact upon their infection dynamics. However, few studies have investigated if this interaction varies across combinations of pathogen-hyperparasite strains, and if this influences hyperparasite incidence in natural pathogen populations. Here, we test if the association between a hyperparasitic fungus, *Ampelomyces quisqualis*, and a single powdery mildew host, *Podosphaera plantaginis*, varies among genotype combinations, and whether this drives hyperparasite incidence in nature. Laboratory inoculation studies reveal that genotype, genotype x genotype interactions, and local adaptation affect hyperparasite infection. However, observations of a natural pathogen metapopulation reveal that spatial rather than genetic factors predict the risk of hyperparasite presence.

17:00 Can we measure the importance of environmental variables controlling species abundances?

Kalle Ruokolainen (University of Turku), Lasse Ruokolainen (University of Helsinki), Hanna Tuomisto (University of Turku), Kalle Parviainen (University of Turku)

Which environmental variables are determining species composition, and which of the studied variables are most important in doing so, is a common question in community ecology. The standard approach is to model species composition through regression and interpret the coefficient of determination (R^2) for each variable as

a direct measurement of its importance in affecting community composition. At least when using either redundancy analysis (RDA) or correspondence analysis (CCA), the R^2 value is known to decrease with increasing length of the studied environmental gradient. Consequently, the R^2 ratio between explanatory variables might also change along with gradient length. Thus far, this possibility has not been studied for RDA or CCA, nor for any other regression methods used in community ecology. Here we do such a study using simple noiseless artificial community data in which two explanatory variables, each with an effect we have defined, fully determine the variation in species abundances. With these data, we examine the performance of seven different regression methods representing analyses of raw data, transformed raw data and distance data. We found that none of the methods produces an R^2 ratio between the explanatory variables that would keep reliably stable as the studied environmental gradient length varies. With many methods, also the rank order between the R^2 values among the explanatory variables changed along the length of the environmental gradients. Our results imply that, contrary to the prevailing interpretation, the relative value of R^2 of an explanatory variable is not indicative of its relative role in structuring the community. We argue that this role of an explanatory variable is better measured by species compositional turnover along the variable or in certain cases by the value of its regression coefficient.

17:15 Depicting grazer control over tundra carbon storage under the present and a warmer climate

Henni Yläanne (University of Oulu), Johan Olofsson (University of Umeå), Lauri Oksanen (The Arctic University of Norway), Elina Kaarlejärvi (Vrije Universiteit Brussel), Maria Väisänen (Climate Impacts Research Center), Minna Männistö (Natural Resources Institute Finland), Saija Ahonen (University of Oulu), Sari Stark (University of Lapland)

Warmer air temperatures and altered species ranges are likely to result in increased release of carbon from high latitude ecosystems. However, there is huge variance in the current predictions of this carbon climate feedback and we do not understand regional controls over carbon storage and release. I plan to present two studies, where we investigated whether grazing by reindeer can alter ecosystem carbon storage by altering the dominant plant functional traits. We quantified recent changes in ecosystem carbon along two pasture rotation fences, where decades of heavy grazing by reindeer on one side of the fence has resulted in a dominance of graminoids over dwarf shrubs that prevail on the lightly grazed side of the fence. Along one of the fences we also measured how four years of experimental warming and fertilization have altered ecosystem carbon, microbial activities and the microbial community composition. Our results reveal that, under ambient conditions, heavy grazing by reindeer decreased aboveground carbon and had positive or neutral effects on the carbon belowground. Experimental warming drastically decreased soil carbon, accelerated the release of microbial extracellular enzymes and favored the dominance of fungi over bacteria. These effects occurred regardless of grazing and the intrinsic and warming-induced dissimilarities between the grazing intensities in vegetation and microbial community composition. Taken together, we show that grazers may control ecosystem carbon storage under ambient conditions, but the grazer control may be concealed by the strong and instant loss of soil carbon in response to warming. Moreover, both studies demonstrate the potential of grazers to control individual processes in the carbon cycle, which contributed to the realized changes in carbon stocks. These results indicate the potential to incorporate grazer management into carbon neutral land-use planning and to soil carbon models.

Aquatic Populations, Communities and Ecosystems in the Anthropocene Session

Chair: Jani Heino

· Wednesday 1.2.

11:00 Biodiversity of a large population complex of Atlantic salmon in the River Teno Jaakko Erkinaro (Natural Resources Institute Finland (Luke))

The subarctic River Teno system (Tana in Norwegian, Deatnu in Sami) forms the border between northernmost Norway and Finland (70 ° N, 28 ° E) and drains an catchment area of 16 386 km². The Atlantic salmon population of the Teno River is among the largest within the distribution area of the species, producing 100-200 metric tonnes (20-50 000 individuals) of annual freshwater catch. The salmon population complex of the system shows a wide variation in life histories and genetic divergence among large number of subpopulations in different parts of the main stem and numerous tributaries of the catchment. Combinations of smolt ages (2-8), maiden sea ages (1-5) and a wide variety of previous spawning times and marine residence years in between, result in a total of 120 different life history groups. Population genetic analyses have confirmed the existence of c. 30 distinct sub-populations, with the genetic differences between subpopulations being typically large, reflecting accurate homing and relatively small gene flow between them. Moreover, the genetic structure appears temporally stable, at least over four decades, based on analyses of DNA from historical archived scale material since early 1970s. The vast diversity poses challenges for conservation and exploitation strategies, especially in light of strong mixed-stock fishery in lower and middle parts of the main stem. Modern genetic methods have been used to assign mixed-stock catches of salmon in the main stem to their population of origin in different parts of the system. This detailed information enables tailoring of population- and life-history group-specific management actions, depending on the status of different populations.

11:15 A comparative analysis of the species richness and taxonomic distinctness of lake acrophytes in four regions: similarities, differences and randomness along environmental gradients

Janne Alahuhta (University of Oulu, Geography Research Unit), Maija Toivanen (University of Oulu, Geography Research Unit), Jan Hjort (University of Oulu, Geography Research Unit), Frauke Ecke (Department of Aquatic Sciences and Assessment, Sweden), Lucinda Johnson (University of Minnesota Duluth, Natural Resources), Laura Sass (Illinois Natural History Survey, Prairie Research), Jani Heino (Finnish Environment Institute, Natural Environment)

There has recently been an intensive search for efficient biodiversity measures which can efficiently quantify natural characteristics and anthropogenic pressures in freshwaters. However, increasing evidence suggests that the performance of different biodiversity measures depends on the studied ecosystem, organisms and geographical location. 2. Our study goal was to compare patterns in species richness and average taxonomic distinctness (AvTD) of aquatic macrophytes along environmental gradients across four study regions (i.e., Finland, Sweden, US state of Minnesota and US state of Wisconsin). 3. We used aquatic macrophyte data along with relevant local (i.e., alkalinity, colour, lake area, maximum lake depth, total phosphorus and number of surveyed transects) and climate (i.e., mean annual temperature) variables surveyed from 50 to 60 lakes using identical methods within each region. Based on linear regression models and Bayesian Information Criterion variable selection method, we correlated species richness and AvTD of lake macrophytes with local environmental and climate variables. 4. Species richness and AvTD of aquatic macrophytes were mostly negatively related in each region. Both biodiversity measures were correlated with environmental gradients to various degrees among the studied macrophyte groups and regions. Species richness and AvTD of macrophytes were best explained in Finland and Minnesota, with alkalinity and total phosphorus being strongest predictors of biodiversity. 5. Our study suggested that variation in different biodiversity indices along multiple

environmental gradients can be considerable for the same biological group studied in different regions. This finding strongly suggests that a biodiversity measure indicating environmental changes in one study region may not be applicable in another region, but complementary indices are needed to efficiently indicate the impacts of anthropogenic pressures on freshwater biodiversity.

11:30 Differential roles of dispersal mode and habitat specialization on the metacommunity structure of shallow beaches

Iván Rodil (University of Helsinki), Paloma Lucena-Moya (University of Helsinki), Henri Jokinen (University of Helsinki), Victoria Ollus (University of Helsinki), Håkan Wennhage (Stockholm University), Anna Villnäs (University of Helsinki), Alf Norkko (University of Helsinki)

Understanding patterns and mechanisms of variation in the structure of communities across spatial scales is a fundamental challenge in ecology. We examined the role of local environmental and spatial patterns in structuring benthic communities on a shallow soft-sediment beach network using a metacommunity ecology approach. We found that both processes contributed to a varying degree to the structure of the local communities suggesting that the interplay of environmental filters and dispersal related mechanisms played key roles in determining abundance patterns. We categorized all the beach benthic invertebrates according to their dispersal mode (i.e., passive vs. active) and habitat specialization (i.e., generalist vs. specialist) to obtain further information on metacommunity dynamics. Passive dispersers were predicted by a combination of environmental and spatial factors, whereas active dispersers were not spatially structured and responded only to local environmental factors. We also found that habitat generalists responded primarily to spatial factors, while habitat specialists only responded to local environmental filtering. Our findings emphasize the complexity of natural benthic ecosystems, and the need to use different categories of species traits as an approach to make accurate predictions about dynamics in metacommunity studies. Our study highlighted the sensitivity of beach macroinvertebrates to eutrophication proxies (e.g., submerged vegetation cover, organic matter or turbidity). A better understanding of the role of the environmental spatial patterns of beach metacommunities will help us to improve our ecological understanding of the coastal zones, and prioritize management actions to cope with pervasive environmental stressors.

11:45 Predator intimidation effects on macroalga-herbivore interaction in the Baltic Sea littoral
Fiia Haavisto (University of Turku), Veijo Jormalainen

Plant quality and predators both influence herbivore population dynamics but their combined effects have rarely been studied. We present a mesocosm study where we explored non-lethal effects of a fish predator on the crustacean herbivore *Idotea balthica* and its main host, the bladder wrack *Fucus vesiculosus*. We exposed bladder wrack and herbivores to water-borne fish cue twice a day over two weeks and recorded changes in herbivore behavior, growth and reproduction. In addition, we quantified magnitude and pattern of herbivory on algae as well as defense induction in bladder wrack using preference bioassays. Cue of fish presence did not affect survival of *I. balthica* but it decreased somatic growth of males by 80 %. Furthermore, in females, predator intimidation extended the duration of intermolt and decreased reproductive output in a size dependent way: the egg mass of the largest females exposed to fish cue was about 15 % smaller than in the control. We also found a cascading predator effect on the bladder wrack quality with decreased herbivore preference of the algae in fish cue treatment. Our study provides evidence that predation risk increase the negative effects of plant defenses on herbivore performance. The combined effect of predation risk and plant defenses on herbivore population dynamics may thus far exceed their single effects, which calls for taking them into account simultaneously in studies of plant-herbivore interaction.

12:00 How important are terrestrial organic carbon inputs for secondary production in freshwater ecosystems?

Sami Taipale (University of Jyväskylä)

Freshwater systems receive high loadings of terrestrial organic matter (t-OM) in the form of dissolved or particulate organic carbon, but it is not usually transferred efficiently to upper trophic levels. Terrestrial particulate organic matter (t-POC) inputs to lakes and rivers are comprised of 80-90% biochemically recalcitrant lignocellulose, which is highly resistant to enzymatic breakdown by animal consumers. Further, t-POC is low in essential biochemical compounds that are critical for rapid growth and reproduction in aquatic invertebrates and fishes. Ultimately, the biochemical composition of a particular basal resource, and not just its quantity or origin, determines how readily this material is incorporated into upper trophic level consumers. However, carbohydrates (glucose) from t-POC can benefit zooplankton by using carbohydrates for energy and saving essential fatty acids and amino acids for somatic growth and reproduction to maximize their somatic growth and reproduction under nutritional stress. Altogether, microalgal production supports most animal production in freshwater ecosystems due to their highly favorable biochemical composition for secondary consumer.

Biodiversity Session

Chair: Craig Primmer

· Wednesday 1.2.

11:00 Resource polymorphism in Arctic charr: an integrative perspective

Skúli Skúlason, Bjarni K. Kristjánsson, Camille A.-L. Leblanc

In order to increase our understanding of the origin and nature of biological diversity an integrated view of ecological, evolutionary and developmental processes is necessary. Northern freshwater fishes that occupied habitats emerging after the last glaciation have since then become highly phenotypically diverse. This diversity is associated with different habitats and prey items and has thus been termed resource polymorphism. It has been shown that ecological factors promote the evolution of resource polymorphism affecting both natural selection and individual development (phenotypic plasticity and parental effects). In some cases the formation of morphs is largely based on phenotypic plasticity while in other cases phenotypic differences of morphs are more canalized. Interestingly, there is evidence that morphs influence their environments in a variety of ways, affecting how ecological factors operate. The salmonid fish Arctic charr (*Salvelinus alpinus*) is a good example of resource polymorphism. We will discuss the implication of integrated ecological, evolutionary and developmental approach for the study of resource polymorphism with focus on our past and current research on the diversity of Arctic charr.

11:15 Ecological uniqueness of stream and lake diatom communities shows different macroecological patterns

Annika Vilmi (Finnish Environment Institute & University of Oulu), Satu Maaria Karjalainen (Finnish Environment Institute), Jani Heino (Finnish Environment Institute)

We aimed to discover if lake and stream diatom communities show different patterns in species richness and in their local (LCBD) and species (SCBD) contributions to beta diversity in relation to macro-scale environmental characteristics.

As biological data, we used diatom samples collected from Finnish stream (n=492) and lake (n=290) sites. As explanatory variable data, we used information on macro-scale environmental and historical aspects, such as bedrock, soil and post-glacial highest shoreline. We also accounted for catchment areas, different levels of isolation and relative centrality of the study sites. We ran multiple linear models, and selected best models based on AICc values. We found that macro-scale

factors affecting diatom richness and ecological uniqueness differed clearly between streams and lakes. LCBD and species richness of stream communities were more affected by regional environmental characteristics, whereas LCBD and species richness of lake communities were more often driven by spatial measures. The measures of LCBD and species richness showed a slightly negative relationship in streams, but no such relationship was detected in lakes. Also, we showed that for both streams and lakes, SCBD was strongly determined by the number of sites occupied by a species and the overall abundance of a species. Our findings related to the distinction between the determinants of lake and stream species richness or LCBD may be tied to the different hydrological connectivity levels occurring in freshwater lotic and lentic systems. Also, in streams, sites with exceptional ecological uniqueness seem to have a rather low number of species. Our findings may be applied to biological conservation and monitoring planning, emphasizing that not only species rich but also unique low-richness sites may be valuable conservation goals.

11:30 Mapping the association between local scale floristic composition and hydrological conditions in Amazonia

Gabriel Moulatlet (Department of Biology, University of Turku), Camilo Rennó (National Institute for Space Research, Brazil), Kalle Ruokolainen (Department of Biology, University of Turku), Hanna Tuomisto (Department of Biology, University of Turku)

Hydrological conditions have long been recognized to affect floristic composition in Amazonian forests. The shores of creeks and ponds, as well as other areas where the water table is close to the surface, harbor different species than drier microsites. Locally, hydrological conditions can be mapped by simple environmental description, but regional mapping is more complex and depends on remote sensing data. The digital elevation model derived from the Shuttle Radar Topography Mission (SRTM-DEM) can be used as input data to predict moisture, but local hydrological conditions can only be accurately mapped when local field data for validation are available. Here we test the correspondence between hydrological conditions as estimated with two different methods: a moisture index based on field-observed plant species abundances, and the vertical distance between a pixel of the SRTM-DEM and the nearest drainage network. SRTM-DEM-based measurements of relative elevation were validated using measurements obtained with a clinometer in seventy-one 500-m-long transects along the Jurua River in Brazilian Amazonia. Plant abundance data collected in the same transects was used to calculate a moisture index, and each species contributed to the index value according to its association with soil moisture. We found a high correspondence between the altimetry from SRTM-DEM and the topographic field measurements. The fern moisture index was highly associated with the vertical distance to nearest drainage when the relative elevation differences within each transect were higher than 10 m, indicating that it is possible to identify hydrological environments using SRTM-DEM. Mapping of Amazonian species diversity and distributions are still challenged by scanty field data. Our results indicate that remote sensing data can help in predicting floristic variability even at the local scale, adding data source to the complex task of mapping Amazonian diversity.

11:45 Using change trajectories to study the impacts of multi-annual habitat loss on fledgling success in an old forest specialist bird

Eric Le Tortorec (University of Jyväskylä / University of Turku), Niina Käyhkö (University of Turku), Harri Hakkarainen (University of Turku), Petri Suorsa (University of Turku), Esa Huhta (Natural Resources Institute Finland), Samuli Helle (University of Turku)

The loss and subdivision of habitat into smaller and more spatially isolated units due to human-caused habitat loss and fragmentation has been shown to adversely affect species worldwide. We examined how changes in old forest cover during eight years were associated with the cumulative number of fledged offspring at the end of study period in Eurasian treecreepers (*Certhia familiaris*) in Central Finland. We were specifically interested in whether the initial level of old forest cover moderated this relation. We applied a flexible and powerful approach, latent growth curve modelling in a structural equation modeling (SEM) framework, to create trajectories describing changes in old forest cover through time, and studied how this change at both the neighbourhood and landscape scales impacted fledging numbers. Our main finding was that at the neighbourhood scale the negative impact of habitat loss on fledging numbers was lessened by the higher levels of initial forest cover, while no association was found at the landscape scale. Our study highlights a powerful, but currently under-utilised methodology among ecologists that can provide important information about biological responses to changes in the environment, providing a mechanistic way to study how land cover dynamics can affect species responses.

12:00 **Is high complexity unbearable?**

Jacqueline Moustakas-Verho (University of Helsinki), O.E. Stenberg (University of Helsinki), J. Anttila (University of Helsinki), J. Jernvall (University of Helsinki)

Bears are an ecomorphologically diverse clade and their dentition reflect the wide range of dietary habits, from the hypercarnivorous polar bear, omnivorous sloth, sun, black, and brown bears to the herbivorous panda bear. The shape of the mammalian dentition is determined prior to eruption and modified only by wear. The complexity of the dentition has been shown to correlate with diet, and we have used this metric to reconstruct the diet of the European cave bear, *Ursus spelaeus*, a member of the Pleistocene megafauna that became extinct during the Last Glacial Maximum. The teeth of the cave bear exhibit the greatest complexity of all bear species, even higher than panda bears, which are specialized bamboo feeders. This suggests that the dentition of cave bears was highly specialized for a vegetation diet, and may not have been sustainable with changing climates and landscapes. An alternative hypothesis that we investigate is that the cave bear became developmentally unstable and ended up in a complexity trap, unable to further produce adaptive change. We contrast this with the simpler dentition of the polar bear, a population currently experiencing habitat fragmentation.

12:15 **How to make more out of community data? A conceptual framework and its implementation as models and software**

Otso Ovaskainen (University of Helsinki)

Community ecology aims to understand what factors determine the assembly and dynamics of species assemblages at different spatiotemporal scales. To facilitate the integration between conceptual and statistical approaches in community ecology, we propose Hierarchical Modelling of Species Communities (HMSC) as a general, flexible framework for modern analysis of community data. While non-manipulative data allow only for correlative rather than causal inference, our framework helps the use of such data in a manner that disentangles community processes as efficiently as possible. We model environmental filtering by variation and covariation in the responses of individual species to the characteristics of their environment, with potential contingencies on species traits and phylogenetic relationships. We capture biotic assembly rules by species-to-species association matrices, which may be estimated at multiple spatial or temporal scales. We operationalize the HMSC framework as a hierarchical Bayesian joint species distribution model, and implement it as R- and Matlab-packages that enable computationally efficient analyses of large datasets. Armed with this tool, community ecologists can make sense of many types of data, including spatially explicit data and time-series data, as we show by examples

Evolutionary Ecology Session

Chair: Leena Lindström

· Wednesday 1.2.

16:00 Explaining biogeographic range size and measuring its effect on species diversification in bark beetles

Jostein Gohli (Metapopulation Research Centre, UH), Lawrence R. Kirkendall (University of Bergen), Sarah M. Smith (Michigan State University), Anthony I. Cognato (Michigan State University), Jiri Hulcr (University of Florida), Bjarte H. Jordal (University Museum of Bergen)

Comparative studies of species diversification can identify the speciation processes that shape patterns of species richness across the tree of life. We have analyzed species diversification and geographical range size in 109 genera of bark beetles, (1) evaluating how three factors: mode of reproduction, symbiotic associations with fungi, and host-plant type influence geographic range size, and (2) tested whether range size is associated with species diversification. We found regular inbreeding and gymnosperm host type preference to predict an increase in geographic range size. Furthermore, we found a strong positive association between biogeographic range size and species diversification rates. Our study supports the idea that range expansion and speciation are intrinsically linked, and that reproductive behaviour and host type preference through their influence on biogeographic dispersal ability are ultimately determining factors of species diversification in bark beetles.

16:15 Habitat specific build-up of temporal isolation in a young hybrid zone

Päivi Sirkiä (Finnish Museum of Natural History), Eryn S. McFarlane (Animal Ecology, Uppsala University), William Jones (Animal Ecology, Uppsala University), David Wheatcroft (Animal Ecology, Uppsala University), Murielle Ålund (Animal Ecology, Uppsala University), Jakub Rybinski (Animal Ecology, Uppsala University), Anna Qvarnström (Animal Ecology, Uppsala University)

Temporal segregation in the onset of reproduction between young species can act as an important source of reproductive isolation (i.e. temporal isolation) that prevents gene flow between species. Divergence in timing of breeding can also facilitate co-existence of competing species by reducing competition over resources. Whether ecological similarities in resource use between species promote or constrain the evolution of temporal isolation remains an open question. In addition understanding on the resource use of competing species is increasingly important as climate change is altering species distributions and coexistence of ecologically similar, competing species. We investigated whether the build up of temporal isolation between two closely related species, pied and collared flycatchers, differed within a young hybrid zone on Öland island in Sweden across the last fourteen years. We compared temporal segregation in different habitat types varying from rich broadleaved deciduous forest with highly seasonal food peak to poor mixed forest with lower but more stable food abundance. We found a higher degree of temporal isolation between the two species within habitats with low but stable food availability, possibly because the lack of a pronounced seasonal peak in food availability allowed more variation in the onset of breeding. We investigate the consequences of temporal segregation and selection acting on the onset of breeding across habitat types. Our results suggest that ecological similarities in resource use can constrain temporal isolation in habitats with strong seasonal peaks in food availability, i.e. where both species need to match their breeding period with a short time-window of high food availability.

16:30 Genetic architecture of age at maturity can generate divergent and disruptive harvest-induced evolution

Anna Kuparinen (University of Helsinki), Jeffrey Hutching (Dalhousie University, Canada)

Life-history traits are generally assumed to be inherited quantitatively. Fishing targeting large, old individuals is expected decrease age at maturity. In Atlantic salmon (*Salmo salar*), it has recently been discovered that sea age at maturity is under strong control by a single locus with sexually dimorphic expression of heterozygotes, which make it less intuitive to predict how life-histories respond to selective fishing. We explore evolutionary responses to fishing in Atlantic salmon, using eco-evolutionary simulations with two alternative scenarios for the genetic architecture of age at maturity: i) control by multiple loci with additive effects and ii) control by one locus with sexually dimorphic expression. We show that multi-locus control leads to unidirectional evolution towards earlier maturation, whereas single-locus control causes largely divergent and disruptive evolution of age at maturity without a clear phenotypic trend but a wide range of alternative evolutionary trajectories and greater trait variability within trajectories. Our results indicate that the range of evolutionary responses to selective fishing can be wider than previously thought and that a lack of phenotypic trend need not imply that evolution has not occurred. These findings underscore the role of genetic architecture of life-history traits in understanding how human-induced selection shape target populations.

16:45 Effect of low environmental antibiotic concentrations on parasite co-infections

Lotta-Riina Sundberg (University of Jyväskylä), Anssi Karvonen (University of Jyväskylä)

Antibiotics are commonly used against pathogenic bacterial infections in agriculture. As a side-effect, this may result in development of antibiotic resistance in the targeted pathogens and in leakage of the compounds into the environment. This is important as such spill-over exposes parasite systems outside the production environment to low concentrations of antibiotics, which could not only change infection dynamics and virulence of environmental bacteria, but also shape infection success of other parasites co-infecting the same hosts. We studied the effects of low concentrations of a widely used antibiotic, oxytetracycline, on two parasite species, the bacterium *Flavobacterium columnare* and the trematode *Diplostomum pseudospathaceum*, infecting their fish hosts in single and in co-infection conditions. We found that antibiotics in feed, and particularly the minute concentrations in water, significantly changed the virulence of infection. However, this depended on the level of antibiotic resistance of the bacterial strains. We also found evidence of antibiotics changing the infection success of the trematode and the outcome of co-infection of the two parasites. Overall, these results suggest that environmental antibiotics can shape disease dynamics outside production systems, which may have significant implications for natural host-parasite interactions.

Population Ecology Session

Chair: Kristjan Niitepöld & Otso Ovaskainen

· **Wednesday 1.2.**

16:00 Decline in geographic genetic structure with increasing trophic level for interacting species in a fragmented landscape

Saskya van Nouhuys (University of Helsinki), Abhilash Nair (University of Helsinki), Christelle Couchoux (University of Sussex)

A fragmented landscape becomes increasingly fragmented for species at higher trophic levels. To persist, higher trophic level species must have life history traits, such as mobility, that facilitate their ability to use resources that become scarce in fragmented landscapes. The mobility of individuals in a population is apparent in the spatial genetic structure of the population in a landscape. We show that for a butterfly, its parasitoid and its hyperparasitoid, spatial genetic structure decreases with increasing trophic level. The butterfly, *Melitaea cinxia* lives as a classical metapopulation in a 50 x 70 km landscape in Finland. It has limited mobility in the landscape resulting in relatively strong geographic genetic structure. The parasitoid wasp *Hyposoter horticola* moves at larger spatial scale. It is insensitive to local host dynamics so it has low geographic genetic structure. The hyperparasitoid *Mesochorus stigmaticus* has even less structure. However, there is some limit to its mobility, which is evident in the temporal variation of genetic differentiation that increases when the population is small, drastically reducing its effective population size. Finally, while both parasitoids are dispersive, they appear to disperse at different stages. The distribution of full siblings of the primary parasitoid in the landscape shows that females tend to spread their offspring among local host populations, whereas the hyperparasitoid females mostly disperse and then parasitizes hosts within a host population.

16:15 Interactions between food resources and infection in boreal vole populations during winter

Otto Huitu (Natural Resources Institute Finland), Kristian Forbes (University of Helsinki), Heikki Henttonen (Natural Resources Institute Finland), Peter Stuart (Trinity College Dublin), Anja Kipar (University of Zurich), Varpu Hirvelä-Koski (Finnish Food Safety Authority), Tapio Mappes (University of Jyväskylä)

Processes limiting the growth of cyclic vole populations have stimulated considerable research and debate over several decades. In Fennoscandia, the peak density of cyclic vole populations occurs in fall, and is followed by a severe winter decline. The severity of this decline has been demonstrated to be greatly influenced by food availability. Declining boreal small rodent populations are also known to be hosts to a multitude of parasites and microbial pathogens. A lack of food resources has been suggested to enhance the negative effects of pathogen infection on host populations, but these interactions remain poorly investigated in natural populations. We carried out two replicated two-factor enclosure experiments to evaluate the individual and interactive effects of infection and food availability on vole populations during a boreal winter. In the first experiment, food supplementation mitigated the winter decline of vole populations, whereas the removal of intestinal nematodes by an antihelminthic had no measurable effect on vole densities, irrespective of food availability. In the second experiment, food again had a strong positive effect on vole winter population growth. The experimental introduction of a bacterial pathogen (*Bordetella bronchiseptica*) induced a population crash, but only in those vole populations which had access to ample food resources. Under food limitation, the bacterium had no additive effects on the rate of vole population decline. Our results reiterate the importance of food resources as a limiting factor for boreal vole populations in winter. Intestinal nematodes appear unlikely to contribute to the cyclic winter decline of boreal vole populations. Conversely, microbial pathogenic infections clearly hold the potential to override the positive effect of food resources, and act as sources of mortality during the crash phase of vole population cycles.

16:30 **Applying population and landscape genetics to study the Finnish dialects**
Jenni Santaharju (University of Helsinki) & Terhi Honkola (University of Turku), Perttu Seppä (University of Helsinki), Kaj Syrjänen (University of Tampere), Outi Vesakoski (University of Turku)

When people move, they may spread their language. Therefore, linguistic data opens a possibility to study the past human migrations and contacts. Here we use hundred-year-old dialect data to study (1) the past linguistic contacts of Finnish people, and (2) the functional connectivity of the landscape explaining the linguistic differentiation of the Finnish dialects. We consider dialects analogous to populations and apply methods from both population and landscape genetics to study the Finnish language. First, we used Bayesian clustering methods (originally designed for population genetics) to estimate the number and geographic locations of the Finnish dialects (linguistic populations), and the exchange of linguistic features (linguistic flow) among them. Second, we evaluated the functional connectivity between dialect areas by compiling a cost distance model over Finland including e.g. water routes, topography and land cover. We found 16 dialects and a major east-west division in the Finnish language. In general, linguistic flow occurred mainly among neighbouring dialects indicating contacts between geographically close areas. However, despite the short geographical distance, we detected less linguistic flow across the east-west border. This is in line with earlier studies suggesting strong division of the Finnish language and its speakers to the eastern and western main populations. We will discuss the effect of landscape in the spread of language during human migrations.

16:45 **Allee Effects, Life History, and Recovery in Fishes**
Jeffrey Hutching (Dalhousie University, Canada)

Studies on small and declining populations dominate research in conservation biology. This emphasis reflects two overarching frameworks: the small-population paradigm focuses on correlates of increased extinction probability; the declining-population paradigm directs attention to the causes and consequences of depletion. Neither, however, particularly informs research on the determinants, rate, or uncertainty of population increase. In contrast, Allee effects (positive associations between population size and realized per capita population growth rate -- also a metric of average individual fitness) offer a theoretical and empirical basis for identifying numerical and temporal thresholds at which recovery is unlikely or uncertain. Notwithstanding a literature permeated by confusion and conflation (of cause with pattern), most meta-analyses used to detect Allee effects (in fishes) have been fraught with data limitation at low abundance, low statistical power, and at least one questionable, but key, assumption. I adopt an alternative approach, examining the correlates of abundance trajectories observed for 19 marine fish populations deemed to have recovered from depletion and 16 that have not, despite threat mitigation. Comparing terrestrial and aquatic vertebrates, population-size thresholds for impaired recovery are likely to be comparatively lower for some taxonomic groups than others. A metric of natural mortality articulated by simply measured parameters associated with body size and growth rate appears to provide an empirically tractable and theoretically defensible correlate of recovery in fishes.

Poster Session

· Tuesday 31.1.

1. Parasite-microbiota interactions potentially affect intestinal communities in wild mammals

Tuomas Aivelo (University of Zürich), Anna Norberg (University of Helsinki)

Detecting interaction between species is notoriously difficult, and disentangling species associations in host-related gut communities is especially challenging. Nevertheless, due to contemporary methods, including metabarcoding and 16S sequencing, collecting observational data on community composition has become easier and much more common. We studied the previously collected data sets of intestinal microbiota and parasite compositions within longitudinally followed mouse lemurs by analysing the potential interactions with diversity metrics and novel joint species distribution modelling. Both methods showed consistent statistical association between certain parasite species and microbial composition. Both unicellular *Eimeria* sp. and cestode *Hymenolepis diminuta* had an effect on diversity of gut microbiota. These parasite species also had negative associations with several bacterial orders. In comparison, closely related species *H. nana* did not have an effect on diversity, and it had positive associations with several bacterial orders. Our results reveal potential interactions between some, but not all, intestinal parasites and gut microbiota. While environmental variables explained almost half of the total variation, of which almost half could be explained by traits of parasites and microbiota, there were no clear patterns regarding mouse lemur individual variables explaining variation in the occurrence patterns of parasite and microbiota significantly. Our results provide new hypothesis for interactions between and among parasites and microbiota to be tested further with experimental studies.

2. Behaviour and survival of outbred hatchery-reared brown trout *Salmo trutta*

Nico Alioravainen (University of Eastern Finland), Pekka Hyvärinen (Natural Resources Institute Finland), Raine Kortet (University of Eastern Finland), Laura Härkönen (University of Oulu), Anssi Vainikka (University of Eastern Finland)

Unintended domestication in hatcheries tends to increase boldness and therefore decrease survival of fish that are supportively released to compensate overfishing of wild salmonid stocks. Experimentally crossbred strains facilitate studies on heritability of life-history traits and their correlations with behavioural traits. To reveal which traits are heritable and to discover underlying associations among traits, we ran an experiment where we crossed migratory hatchery brown trout *Salmo trutta* with wild resident and three distinct migratory hatchery strains, and studied their survival under predation risk both in semi-natural conditions and in the wild. We used natural predator, pike (*Esox lucius*), to assess experimentally the boldness and the survival of one year old trout. By fitting GLMER and GLM models we showed that not only small size but behavioural differences explained the probability of becoming predated. We found also a significant strain-dependent difference in predator avoidance among fish that survived until the end of the experiment, which may indicate a genetic loss of anti-predatory behaviours in hatchery-reared fish. Indeed, wild x hatchery hybrids visited less and spent less time in areas where pike predation occurred, and thereby their mortality was lower than pure hatchery strain conspecifics. Genetic background did not explain recapture probability in River Varisjoki, but recaptured wild x hatchery hybrids were longer than recaptured hatchery fish in August (1.5 months after release). Our results highlight the importance of negatively size-dependent natural predation as favouring fast growth among fish with high value for fisheries.

3. Dynamics of infectious disease inferred from historical parish records in Finland

Jani Anttila (University of Helsinki), Veijo Kaitala (University of Helsinki), Per Lundberg (University of Lund), Mika Kallioinen (University of Turku), Virpi Lummaa (University of Turku), Tarmo Ketola (University of Jyväskylä)

Our ability to control infectious disease has been recently questioned by emerging diseases, such as ebola and zoonotic influenzae, as well as multi-resistant strains of bacterial diseases. Intriguingly, the development of modern medicine has essentially barred most of the large epidemics worldwide, hindering predictions on epidemic spread of a new disease or a multi-resistant strain. On the other hand, many diseases prevalent in developed countries a century ago remain a threat to human health in developing countries. Studying historical records of disease mortality gives us a view on how infections spread and kill if no effective treatment is available and allow for testing the role of the biology of diseases and spatial network structure on the severity of epidemics. We have collected data from historical parish records in Finland, and used this information to test hypotheses concerning disease spread in spatial networks of pre-industrial households. Based on the records we can compare different infectious diseases (e.g. tuberculosis, rickettsia, pneumonia, smallpox, typhus, measles, shigellosis). Information is gained from several differently behaving diseases in the very same landscapes making it possible to infer landscape specific patterns from disease biology. In addition to spatio-temporal statistical comparisons, we are in the process of developing a dynamical model of epidemic spread on a household network structure, and fitting the parameters to observed mortality patterns. With a validated model and reasonable parameter estimates, we can make predictions on epidemic spread and simulate the effectiveness of different control strategies.

4. Novel application of high resolution melting assay (HRM) to study temperature-dependent intraspecific competition in a pathogenic bacterium

Roghaieh Ashrafi, Matthieu Bruneaux, Lotta-Riina Sundberg, Katja Pulkkinen, Tarmo Ketola

Studies on species responses to climate change have focused largely on the direct effect of abiotic factors and in particular temperature, neglecting the effects of biotic interactions in determining the outcome of climate change projections. Many microbes rely on strong interference competition; hence the fitness of many pathogenic bacteria could be a function of both their growth properties and intraspecific competition. However, due to technical challenges in distinguishing and tracking individual strains, experimental evidence on intraspecific competition has been limited so far. Here, we developed a novel and robust application of high-resolution melting (HRM) assay to study head-to-head competition between mixed genotype co-cultures of a waterborne bacterial pathogen of fish, *Flavobacterium columnare*, at two different temperatures. We found that competition outcome in liquid cultures seemed to be well predicted by growth yield of isolated strains, but was mostly inconsistent with interference competition results measured in inhibition tests on solid agar, especially as no growth inhibition between strain pairs was detected at the higher temperature. These results suggest that, for a given temperature, the factors driving competition outcome differ between liquid and solid environments.

5. Spatial processes and wind disturbance play major roles in metacommunity organization in an anthropogenically-altered freshwater ecosystem

Yongjiu Cai (Nanjing Institute of Geography and Limnology, Chin), Hao Xu (Nanjing Institute of Geography and Limnology, Chin), Annika Vilmi (Finnish Environment Institute), Kimmo Tolonen (Finnish Environment Institute), Xiangming Tang (Nanjing Institute of Geography and Limnology, Chin), Boqiang Qin (Nanjing Institute of Geography and Limnology, Chin), Zhijun Gong (Nanjing Institute of Geography and Limnology, Chin), Jani Heino (Finnish Environment Institute)

Assembly mechanisms of aquatic metacommunities have so far been focused almost on relatively isolated systems, such as a set of streams, lakes or ponds. Here, we aimed to quantify the relative importance of spatial

processes (dispersal), natural factor and anthropogenic stressors in structuring variation in macroinvertebrate community within a large and highly-connected shallow lake system. The roles of different drivers were evaluated for entire community, ten trait-based deconstructed communities and four common species by incorporating extensive sampling and abiotic explanatory variables. Contrary to the expectations, we found that variation in community structures were mostly correlated to spatial and wind wave variables rather than anthropogenic disturbance factors even if the lake suffered intensive human pressures. In further, the relative importance of the three drivers for different deconstructed communities adhered to the traits that is dispersal ability, feeding mode and occurrence. Importantly, distribution of common species showed significant spatial autocorrelation, indicating the prominent role of high dispersal rate (i.e., mass effect). These findings suggest that the influences of mass effects and natural disturbance may overwhelm the role of anthropogenic stressors in metacommunity organization in highly-connected aquatic systems. Hence, we strongly encourage spatial processes and natural drivers should be taken into account in development of bioassessment approaches in highly-connected systems.

6. Taxonomy and evolutionary history of the neotropical fern genus *Salpichlaena* (Blechnaceae)

Glenda Gabriela Cárdenas Ramírez (University of Turku), Samuli Lehtonen (University of Turku). Hanna Tuomisto (University of Turku)

The neotropical fern genus *Salpichlaena* (Blechnaceae) is interesting both because it has an unusual climbing habit and because there has been much debate during the past three decades about how many species the genus contains. Some researchers recognize 2 or 3 species whereas others consider there to be just one. The habit of these plants has caused some difficulty for taxonomical work. They have twice pinnate twining leaves that can become more than 5 m long, and the pinnae vary considerably in both size and shape according to their distance from the rhizome. We have now systematically observed 62 morphological traits on 183 herbarium specimens of *Salpichlaena*. We found that the plants can be separated into several morphologically consistent groups on the basis of pinna texture, shape of pinna apex, type of pinna margin, presence of buds on pinna axils and shape of the scales on the costa. We also sequenced three plastid genes (*rbcL*, *rpoC1* and *rps4*), two plastid intergenic spacers (*trnH-psbA* and *trnG-trnR*) and a nuclear gene (*pgiC*) from 46 *Salpichlaena* and nine out-group specimens to run phylogenetic analyses. Preliminary results indicate that the morphological and molecular classifications are identical, so we suggest that the genus contains at least five species. One of these is geographically widespread in Central and South America, whereas the others have more restricted ranges. The species also differ ecologically: one is only found in swamp forests, two are found in well-drained lowland forests but in different geographical areas, and one is restricted to montane forests.

7. Density-dependent effects of *Borrelia afzelii* infection in the bank vole

Claire Cayol (University of Jyväskylä, Biol. & Env. Science), Anna Giermek (Jagiellonian University, Env. Sciences), Jukka Hytönen (University of Turku, Medical Microbiol. & Immuno), Esa Koskela (University of Jyväskylä, Biol. & Env. Science), Tapio Mappes (University of Jyväskylä, Biol. & Env. Science), Jemiina Salo (University of Turku, Medical Microbiol. & Immuno), Eva Kallio (University of Jyväskylä, Biol. & Env. Science)

The outcome of a host-pathogen interaction varies upon pathogen virulence as well as host characteristics and immune competence in a given environment. Some pathogens significantly reduce their host fitness and alter their host population dynamics. However, in most cases, endemic infections in natural hosts are long lasting chronic and asymptomatic infections favoring pathogen transmission. Besides, in order to further enhance their transmission, many vector-borne pathogens alter phenotypic traits of their natural host. It is critical for the understanding of vector-borne pathogens transmission and maintenance in natural systems, that the fine scale host-pathogen interactions are clarified. Here, we investigate the effects of *Borrelia afzelii*, the bacteria responsible for Lyme borreliosis, the most prevalent human vector-borne disease in the northern hemisphere, on the fitness of its rodent host the bank vole *Myodes glareolus*, using a novel experimental setup in large

outdoor enclosures in two contrasting population densities mimicking abundance fluctuations observed in bank vole populations of our study area. We monitored the bank vole survival, reproductive success, body condition, spacing behavior and anti-borrelia antibody levels. We found that in its early stage, infection with *Borrelia afzelii* cannot be qualified as asymptomatic. Infected males with large structural size showed altered reproductive success, whereas infected females sped up breeding. We found density-dependent variation in home range size and reproductive success in male bank voles. Altogether, our results indicate that infection potentially disrupt sexual selection in bank vole by reducing reproductive success of large males. Besides, the density-dependent effects shown here might indicate different infection outcomes in various stages of the population cycle in a cyclic species.

8. Expert knowledge elicitation and calibration in ecological research: A case study in data-limited fisheries stock assessment

Anna Chrysafi (Department of Environmental Sciences, University of Helsinki), Jason Cope (Fisheries Resource Assessment and Monitoring Division, NOAA, USA), Anna Kuparinen (Department of Environmental Sciences, University of Helsinki)

Data-limited fisheries are a major challenge for stock assessment analysts, as many traditional data-rich models cannot be implemented. Approaches based on stock reduction analysis offer simple ways to handle low data availability, but are particularly sensitive to assumptions on relative stock status (i.e., current biomass compared to unperturbed biomass). For the vast majority of data-limited stocks, stock status is unknown. In this study, we elicited expert knowledge to inform stock status and developed a novel, user-friendly on-line application for expert elicitation of this value. We compared expert opinions to stock status derived from data-rich models and evaluated how experts with different levels of experience in stock assessment performed relative to each other and with different qualities of data. Our results demonstrate the degree and drivers of bias and imprecision in expert opinions. Given the sensitivity to stock status misspecification for some popular data-limited methods, these cognitive biases should be taken under consideration when applying those values. Thus, we further develop a tool that can improve expert elicited values using calibration data. Such an approach can have applications in both terrestrial and marine wild population conservation and sustainable management when expert knowledge is required.

9. The relationship between size and reproduction in female Asian elephants

Jennifer Crawley, Simon N. Chapman, Mirkka Lahdenperä, Khyne U. Mar, Win Htut, Aung Thura Soe, Htoo Htoo Aung, Virpi Lummaa

Limited resources impose trade-offs between growth, reproduction and maintenance, though less is known of the trade-offs with growth than of reproduction versus survival. Some studies have shown reproduction to suppress growth, whereas in others reproduction positively correlates with size. We assess the relationships between size, reproduction and survival using detailed records from a large population of semi-captive Asian elephants in Myanmar, a species characterised by slow, costly life history. Although height gain overlapped little with population level reproductive onset in females, we found large variation in age at primiparity, and only 81% of average final weight had been reached by the peak age of reproduction (19yrs). Early first reproduction and high reproductive investment were not associated with reduced mature height. Those beginning reproduction early were however significantly lighter than those starting later, suggesting a cost to reproduction at early ages. Reproductive females were both significantly taller and weighed more than non-reproducers, suggesting reproduction may be limited to larger, heavier females. This positive relationship between size and reproduction reduces with age, which could be due to lower reproductive costs at older ages, or faster early growth in the reproductive females ceasing, allowing smaller females to catch up at later ages. We found no evidence that small size is linked to lower survival, suggesting selective disappearance is not driving this relationship. Our results suggest that reproduction may not always impose significant costs on

growth, but it may impact body condition reflected in weight differences and that size may be a major limiting factor to reproductive investment.

10. Low genetic structure and high diversity in space and time in a butterfly metapopulation

Michelle DiLeo (University of Helsinki), Arild Husby (University of Helsinki), Marjo Saastamoinen (University of Helsinki)

The spatial distribution of genetic variation can have important influences on the evolutionary dynamics of populations. Understanding how the distribution of genetic variation changes through time in response to changes in population size is increasingly important, as climate change is expected to increase both the frequency and amplitude of population fluctuations. Here we quantified spatiotemporal genetic structure of the Glanville fritillary butterfly (*Melitaea cinxia*) in the Åland Islands, Finland, using individuals sampled from nine networks of dry meadows over an eight year period. We found low metapopulation-wide genetic structure and high turnover of assignments to genetic clusters through time, suggesting high levels of gene flow among networks. Despite demographic bottlenecks and fluctuations in population size, networks of meadows occupied by *M. cinxia* were found to maintain high levels of heterozygosity over the eight year period. Together, these preliminary results suggest that sustained gene flow among networks might be important for the maintenance of genetic diversity during population declines in this system. Ongoing work seeks to 1) quantify the importance of individual meadows and networks to the maintenance metapopulation-wide genetic diversity, and 2) resolve the role of polymorphisms identified in flight-related genes which might help to mediate the genetic response to population bottlenecks by increasing the scale of gene flow.

11. Subfossil Cladoceras in large shallow lakes with intensive aquaculture along the Yangtze River, China: controlling factors of their distribution and environmental implications

Xuhui Dong (Aarhus Institute of Advanced Studies, Høegh-Guldbe), Giri Kattel (Nanjing Institute of Geography and Limnology, Chin), Thomas Davidson (Department of Bioscience, Aarhus University, Vejls), Erik Jeppesen (Department of Bioscience, Aarhus University, Vejls)

Cladocera (Crustacea) are an essential component of the foodweb of shallow lakes and their importance as sentinels of environmental change in lakes has been well documented. Most of the studies on cladocera s distribution and ecology are based on European and North American lakes. In subtropic region where normally with strong human disturbance, however, limited work has been conducted, for example in the lakes from the Eastern China. In this study, the distribution pattern in cladoceran subfossils in the surface sediments of 62 shallow lakes in the middle and lower reaches of the Yangtze River Basin (MLYB) was examined. Multivariate methods, including regression trees and ordination, were applied to explore the relationships between the cladoceran taxa distribution and contemporary environmental variables. Partial constrained ordination of sub-fossil cladoceran assemblages indicated that both submerged macrophyte abundance and lake nutrient status (chl-a and total phosphorus concentration) significantly influenced the community composition of cladocera. The multivariate regression tree analysis also showed the distinct differences in cladoceran along the gradients of nutrient and the abundance of aquatic plant. The predation from fish, although being extremely intensive due to aquaculture in these lakes, does not exhibit significant effects on cladocera s distribution. The comparison of the planktonic cladocera composition from the water column and surface sediments exhibited a significant difference, indicating that the lake sediments provide a fragmentary and an incomplete picture of the living cladocera community. Even though, we identified various environmental indicators (*Bosmina longispina*, *Leydigia acanthocercoides*, *Leydigia leydigi*, *Chydorus sphaericus*) to various stressors and assessed the potential of using cladocera for reconstructing historical ecological characters in MLYB lakes.

12. Wolbachia increases host susceptibility to hyperparasitism

Anne Duploux (MRC), Saskya van Nouhuys (MRC)

The success of maternally transmitted endosymbiotic bacteria, such as *Wolbachia*, is directly linked to their host reproduction but in direct conflict with other parasites that kill the host before it reaches reproductive maturity. Therefore, symbionts that have evolved strategies to increase their host's ability to evade lethal parasites may have high penetrance, while detrimental symbionts would be selected against. In a natural population of the parasitoid wasp *Hyposoter horticola* in the Åland Islands, the *Wolbachia* strain wHho persists at an intermediate prevalence. Additionally, there is a negative correlation between the prevalence of *Wolbachia* and a hyperparasitoid wasp, *Mesochorus cf. stigmaticus*, in the landscape. We addressed the persistence of *Wolbachia* at this intermediate level, and tested whether the observed negative correlation could be due to *Wolbachia* inducing either susceptibility or resistance to parasitism. We show that infection with *Wolbachia* does not influence most of the life-history traits investigated, including the ability of the wasp to parasitize its butterfly host, *Melitaea cinxia*. In contrast, we demonstrate that hyperparasitism of the wasp increases in the presence of wHho. Consequently, the symbiont is detrimental and must, in order to persist in the host population, provide a yet uncharacterized positive effect on host fitness that outweighs the costly burden of susceptibility to widespread parasitism.

13. MERCES: Marine Ecosystem Restoration in Changing European Seas

Karine Gagnon (Åbo Akademi University), Christoffer Boström (Åbo Akademi University)

Ecosystem restoration is a growing area of research in terrestrial, aquatic and marine ecosystems. The goal of restoration projects is to reverse habitat loss and restore degraded habitats, thus re-establishing healthy ecosystems with high native biodiversity and ecosystem functions. In marine systems, restoration has been attempted in different habitats, but success rates are often low, and several knowledge gaps have been identified. MERCES is a new EU project on marine ecosystem restoration involving 28 institutions across Europe. The project aims to confront these knowledge gaps, by developing and improving restoration methods in three different marine ecosystems: deep-sea habitats, shallow hard-bottom macroalgal beds, and soft-bottom seagrass meadows. MERCES will run from 2016-2020, and involve multidisciplinary techniques: field and lab experiments, monitoring of restoration sites, mathematical modeling, analyzing socio-economic benefits, and transferring knowledge to stakeholders. We hope to improve both the state of European marine habitats, and our knowledge of the measures necessary for successful ecosystem restoration.

14. Multiple interacting processes maintain colour polymorphism in the wood tiger moth

Swanne Gordon (University of Jyväskylä), Bibiana Rojas (University of Jyväskylä), Emily Burdfield Steele (University of Jyväskylä), Ossi Nokelainen (University of Jyväskylä), Katja Ronka (University of Jyväskylä), Hanna Kokko (University of Zurich), Johanna Mappes (University of Jyväskylä)

The existence of polymorphism in aposematic warning signals is puzzling. Individuals that bear the most common signal should have a survival advantage due to efficient predator learning. This positive frequency dependence should select for fixation of the most common morph. Yet many aposematic organisms are polymorphic, suggesting that other processes must come into play. Here we explored whether counteracting frequency dependent selection on reproduction and predation can maintain polymorphism in the aposematic wood tiger moth. We tested this by observing both mating behavior and predation under different morph frequencies in enclosure experiments. Surprisingly, we found that mating success is positively frequency dependent for both morphs, but that predation is only positively frequency dependent for the white morph. One way that positive frequency dependence could still lead to polymorphism is if it is considered in a spatial context. For example, environmental heterogeneity in predator community may vary baseline morph preferences and favour different morphs in different populations. These differences can result in mixed populations under even small amounts of gene flow. We therefore discuss this hypothesis using collected data on multiple populations and a mark-recapture study to examine local variation in moth-specific survival in the wild. Overall, we show

that multiple factors including spatio-temporal variation in predation, sexual selection, and gene flow interact to maintain the dimorphism observed in wood tiger moth populations.

15. The effect of thermal variability on host-parasite relationships in the wild

Hanna Granroth-Wilding (University of Helsinki), Ulrika Candolin (University of Helsinki)

Parasites and disease are ubiquitous influences on the behaviour and fitness of their hosts, yet our understanding of how infection affects demographic processes in wild populations remains poorly parameterized. This impedes our ability to predict how the impacts of parasites and pathogens on their host populations will change as the climate changes, putting hosts under environmental as well as immune stress. Previous laboratory work has indicated that three-spined sticklebacks (*Gasterosteus aculeatus*) infected with a cestode parasite (*Schistocephalus solidus*) suffer greater costs in warmer water, implying that the parasite will become more important as a population regulator. We tested whether this pattern is visible in a complex natural setting, by sampling stickleback populations at 6 Finnish sites with differing thermal environments throughout the breeding season to quantify infection prevalence and host population structure. Contrary to the lab outcomes, we found no evidence that temperature altered the impact of the parasite on host individuals or populations in the field. Nonetheless, parasite infection was associated with reduced host condition and reproductive capacity, demonstrating its potential to shape host population processes. We explore possible explanations for this lab-to-field inconsistency and its consequences for predicting how host populations will respond to the combined stresses of climate change and infection.

16. Childhood environment mediates sex differences in adult mortality in humans

Robert Griffin (University of Turku), Adam Hayward (University of Stirling), Elisabeth Bolund (Uppsala University), Alexei Maklakov (Uppsala University), Virpi Lummaa (University of Turku)

Life expectancy in humans has increased since industrialization, but increasingly frequent female-biased lifespan suggests that the associated environmental changes may not benefit the sexes equally. Using life history data on individuals born over a 110-year period in two pre-industrial human populations in Finland, and a variety of environmental factors, we show that the childhood environment relates to adult mortality in both sexes similarly, but not equally. Lifespan is increased in cohorts with good crop yields, low spring temperatures, and higher infant mortality rates. Males are, however, more sensitive to early-life environments, specifically showing greater increases in adult mortality rate when infant mortality rate is low and spring temperature is high. These findings support that sex differences in adult mortality may be influenced by environmental variation, and that subsequent variation in sex differences may stem from sex differences in viability selection. Our results were consistent with the modern global trend of increasing female-bias in lifespan.

17. Alarm pheromone as a fear factor in small rodents

Marko Haapakoski (University of Jyväskylä), Alwin A. Hardenbol (Wageningen University), Kevin D. Matson (Wageningen University), Thorbjörn Sievert (University of Jyväskylä), Helinä Voipio (University of Helsinki), Hannu Ylönen (University of Jyväskylä)

Predation involves more than just predators killing and consuming their prey. Predators also can affect how prey perceive the risk of predation, and effect on perception has consequences for prey demography. For example, laboratory experiments have shown that mice and rats can recognize a stressed conspecific from the alarm pheromones left behind by stressed individuals. These rodents then change their behaviour in ways that are similar changes that follow direct encounters with predator cues. In fact, alarm pheromones share structural similarity with predator scents. The ecological and evolutionary significance of alarm pheromones in wild mammals remains unclear. Our aim was to discover how alarm pheromone affects the behaviour and fitness of wild bank voles (*Myodes glareolus*) in large outdoor enclosures. We tested the effect of alarm pheromone by utilizing bedding materials of male voles that were exposed to a predator; control bedding was collected from

unexposed brothers of the exposed voles. After spreading both types of bedding materials in the study enclosures, we found a ca. 50% increase in litter size in enclosures with alarm pheromone bedding compared to control bedding. Female voles seemed to be more attracted to alarm pheromone beddings whilst males avoided it. Movement areas and foraging outcome measured as giving up density were not significantly affected by bedding type. Our results suggest that alarm pheromone may result in population level effects, including through indirect mechanisms involving prey individuals that did not directly encounter a predator.

18. Biodiversity effects of constructed and restored wetlands an ecological and socioeconomical approach
Iлона Helle (University of Jyväskylä), Panu Halme (University of Jyväskylä), Atte Komonen (University of Jyväskylä), Riikka Paloniemi (Finnish Environment Institute)

Wetlands are highly productive ecosystems with characteristics of both terrestrial and aquatic ecosystems. They have special biota adapted to inundation by water. Between 1970 and 2008, natural wetlands declined on average by about 30% globally and 50% in Europe. The severe loss of natural wetlands, as well as their degradation by agriculture, forestry and other human activity, has caused declines in natural wetland habitat types and specialized species, for example waterfowl populations in Finland. During the last decade, wetlands have been protected, restored and even constructed to save the diversity of wetland biota. My PhD project focuses on the biodiversity of constructed and restored wetlands on agricultural areas. The aims of the project are, first, to investigate the effects of the characteristics, i.e. size, mean water depth, shoreline length and age of wetlands on vegetation and on waterbirds, and, second, the effects of regional land use and wetland connectivity on waterfowl diversity, densities and breeding success. Moreover, I study the motives of landowners to apply EU-subsidies for wetland construction and the cost-effectiveness of such subsidies. The results can be applied in cost-efficient construction and restoration of wetlands with high biodiversity values. In my poster at Oikos 2017, I will present an overview of my PhD study and the main field methods.

19. Rewarding farmers for biodiversity results

Traci Birge (UH), Marjaana Toivonen (UH), Minna Kaljonen (Finnish Environment Institute), Irina Herzon (UH)

The agri-climate-environment payment schemes to farmers are the largest public spending for conservation. Results-oriented approaches are regarded as a means to improving currently poor cost-effectiveness of the schemes though targeting payments to the most valuable sites and engaging payment recipients in proactive delivery of biodiversity. We designed a hypothetical payment-by-results scheme for biodiversity conservation on environmental grasslands in Finland. The scheme would pay farmers a premium if the site contains a set number of indicator species. We used data from a vegetation survey on environmental grasslands in three regions in Finland to derive an indicator species list. We presented the hypothetical scheme to 20 farmers and six experts (researchers, officials and advisors) in agricultural policy for their opinions on the payment-by-result approach generally and the hypothetical scheme specifically. The indicator species list proved suitable for identifying sites with high total species richness of vascular plants and also appeared feasible in the eyes of the farmers. Farmers were mostly positive about the approach and, mainly, thought their peers and society-at-large would receive it positively. The main concerns were about implementation, especially verifying the biodiversity results. People working for the national control body were the most critical and could not see how the hypothetical scheme could fit into the current institutionalised programme. Experience in other countries would provide solutions for overcoming such obstacles. The results from this socio-ecological study are highly relevant for a cost-efficient delivery of public goods for public money.

20. Significance of plasticity of behaviour and brains in salmon conservation

Heikki Hirvonen (Integrative Ecology Unit, University of Helsinki), Jussi Koskinen (Integrative Ecology Unit, University of Helsinki), Simon Uphill (Integrative Ecology Unit, University of Helsinki)

Captive breeding and restoration programmes are widely used for animal conservation with huge economical investments but unfortunately often without much result. Low success of captive breeding programmes is mainly due to inferior behavioural skills and consequent low survival of the animals after release to the wild. Our findings with Atlantic salmon open new doors in understanding and solving the open questions: Why do behavioural skills deteriorate so quickly after just a single generation or within only a couple of generations in captive breeding? How can the negative effects of adaptation to captivity be mitigated? Are the mitigation measures efficient enough in improving post-release performance and survival? What is the role of brain plasticity? We found that the salmon showed significant phenotypic plasticity in both foraging behaviour and brain growth, both being enhanced in naturalized vs. standard unnatural rearing environment independent of parent origin (captive vs. wild). Adaptive behaviour in the wild was selected against in captivity and further weakened by unnatural rearing environment. These effects were related to decreased brain development, but compensative brain growth was observed six weeks post-release. Using wild parents and a new more natural rearing method promoted brain growth and larger-brained salmon showed better post-release foraging performance. Our results are directly applicable to improve success of salmon captive breeding and restoration programmes, as we used production scale rearing in the experiments.

21. Long-term genomic coevolution of host-parasite interaction in natural environment

Elina Laanto (University of Jyväskylä), Ville Hoikkala (University of Jyväskylä), Janne Ravantti (University of Helsinki), Lotta-Riina Sundberg (University of Jyväskylä)

The antagonistic coevolution of parasite infectivity and host resistance alters the biological functionality of species, with effects spanning to communities and ecosystems. Still, empirical evidence on long-term host-parasite coevolution in nature is largely missing, and the role of host resistance mechanisms for parasite evolution is poorly understood, necessitating for molecular and phenotypic characterization of both coevolving bacteriophages and their hosts. We combined long-term field sampling (2007-2014), in vitro cross-infections and time-shift experiments with phage whole genome sequencing and bacterial CRISPR (Clustered Regularly Interspaced Short Palindromic Repeats) profiling to show the molecular details of the phage-bacterium arms race in the environment. Bacteria were generally resistant to phages from the past and susceptible to phages from the future. The bacterial resistance selected for increased phage infectivity and host range, correlating directly with expansion of phage genome size by 2656 bp. In the bacterial host, two CRISPR loci were identified; a putative type II-C locus, and a type VI-B locus. While maintaining a core set of conserved spacers, phage-matching spacers appeared in the variable end of both CRISPR loci over time. Appearance of these CRISPR spacers in the bacterial host often corresponded with arms race -manner molecular changes in the protospacers of the coevolving phage population. This is the first demonstration of the evolution of an RNA-targeting CRISPR-system (type VI) in nature. However, the phenotypic data indicated, that compared to constitutive defense, the relative role of CRISPR defense may be less in high phage pressure, highlighting the importance of our findings for understanding microbial community ecology, and in development of phage therapy applications.

22. Attractiveness depends on social environment

Juhani Hopkins (University of Oulu), Arja Kaitala (University of Oulu)

Attractiveness to mates is relative: even a small ornt will appear attractive if there are no competitors to compare it against. A less attractive partner may either move away from competitors or try to get a mating by sneaking close to attractive ones. Thus distance to competitors may have a strong effect on how effectively mates are attracted. Large distance reduces competition, while proximity may enable stealing mates from competitors.

Such alternative strategies are common among males, but unstudied in females. We describe two models examining optimal distance of a less attractive individual from a stronger competitor including when to signal and when to try stealing mates. We test our model's predictions using the common glow-worm (*Lampyrus noctiluca*) where wingless females glow to attract a partner. Males select females based on glow and the brightest females attract the most males. The models together with the experiments reveal two alternative reproductive strategies for sexual signallers. They should either move far from each other and signal or aggregate close to a competitor and parasitize it. The results show that while ornament strength is important in sexual selection, location is just as important as ornament size in determining the result of mate attraction.

23. Does matrix matter? Homogenization in boreal forest bird communities. (tentative)

Matti Häkkilä, Nerea Abrego, Otso Ovaskainen, Mikko Mönkkönen

The process of biotic homogenization, or increasing similarity of natural communities, is accelerating as a consequence of human land-use. Fragmentation and destruction of habitats is affecting most species groups. Setting aside areas from human usage is a common protocol when trying to maintain biodiversity. Protected areas are designed to be free from human-caused disturbances, but are often surrounded by matrix, which is often heavily managed. Landscape change in the matrix may have effects on species in protected areas, and small, isolated protected areas may not be able to maintain their biological diversity. In addition, if the original species pool in the landscape is maintained but communities become more similar (homogenized), the ability of protected area network to maintain diversity is decreased. We studied how the characteristics of the protected areas are affecting community composition. We also studied how matrix quality is affecting the dissimilarity of bird communities, thus, how the protected area network is working. Finally, we studied how much traits of forest bird species explain the variation in community composition and if different traits respond differently to the habitat characteristics both in the protected areas and in the matrix. To achieve this, we used joint species distribution modeling on bird data from 91 protected areas in Northern Finland and landscape data from the areas and 5 km buffer zones surrounding them. We found that matrix does have an effect on bird communities, but still, it is the characteristics of the areas and especially traits of the species that play more important roles in determining community composition. Our results show that especially large protected areas are important in maintaining biodiversity, but even they are not independent from the surrounding matrix.

24. The effect of landscape structure on dispersal distances of Eurasian red squirrel

Suvi Hämäläinen (University of Turku), Karen Fey (University of Turku), Alexandre Villers (University of La Rochelle), Vesa Selonen (University of Turku)

Landscape structure affects dispersal and gene flow of a species. For example, the ongoing human induced fragmentation of habitats can inhibit movement and affect dispersal behavior. For forested species large open areas, like fields in rural areas, can increase risk of predation and may act as barriers for movement. Open areas may thus have an effect on population dynamics and genetics of the whole species. Gap crossing willingness can vary between species and individuals and affect movements during dispersal. In particular, the urban areas are highly fragmented, consisting of buildings, roads and small habitat patches, which may affect movement ability of individuals more than in rural environment. Here, we study how landscape structure affects dispersal distances of Eurasian red squirrels (*Sciurus vulgaris*) in rural and urban areas. We record dispersal behavior in relation to local landscape, by radio tracking juvenile red squirrels during their natal dispersal period in two distinct study areas; urban areas of city of Turku, and rural areas of southern Ostrobothnia. Our data show that dispersal distances at rural areas are several times longer compared to those at the urban study area. We analyze the landscape that animals have used during their natal dispersal, and the landscape that surrounds the individual in order to find out if specific landscape features are behind differences in dispersal distances.

25. Estimating effectiveness and side-effects of legal protection of the Siberian flying squirrel

Maarit Jokinen (University of Helsinki), Otso Ovaskainen (University of Helsinki), Sanna Mäkeläinen (University of Helsinki), Riikka Paloniemi (SYKE), Teppo Hujala (LUKE)

Our understanding of threats to biodiversity and the effort put to protecting it have increased rapidly during the past decades. Yet, as this positive development has happened side to side with increase in harmful human actions, we have not managed to halt the loss of biodiversity. The role ecologists can play in this story depends on whether the problem is the lack of information, lack of development of effective policy measures, or the lack of will to make necessary changes. In the context of developing biodiversity policy, the value of information is defined by its relevance for decision makers: they need information on the effectiveness of different protection measures and strategies. We have studied the effects of legal protection of the Siberian flying squirrel, *Pteromys volans*, in Finland. Protection of this species is based on the Habitats Directive, which is one of the cornerstones of Europe's biodiversity protection policy. Despite the highest legal protection status, and the proportionally high effort put into enforcing the legislation, species population is still in a steep decline. We found that the discussion about the protection of the species has ignored important issues. The debate on the adequacy of logging restriction on nest sites has missed the fact that logging restriction could be effective only if we would have adequate information on these sites. We found that the great majority of nest sites are, and probably will remain, unknown. Also, despite public narratives, the most important compliance issue does not seem to be the so called shoot, shovel and shut up tactic employed by landowners, but the lack of information and motivation to protect the species. Therefore the faith of the Finnish flying squirrel population may depend more on development of forest management standards than the legal protection.

26. Symbiont diversity of *Coccocarpia* in New-Caledonia and Kenya

Jylhä, Maarit (Department of Biosciences, University of Helsinki), Kaisa Jauhiainen (Department of Biosciences, University of Helsinki), Ulla Kaasalainen (Department of Geobiology, University of Göttingen), Jouko Rikkinen (Department of Biosciences, University of Helsinki)

We studied symbiont diversity in the lichen genus *Coccocarpia* (Coccocarpiaceae, Peltigerales) collected from New Caledonia and Taita Hills in Kenya. The ITS (internal transcribed spacer) gene was sequenced to determine fungal species identities and to study phylogenetic relations. Cyanobionts were identified on the basis of tRNA^{Leu}(UAA) intron sequences and haplotypic networks were constructed to illustrate sequence differences between different cyanobacterial genotypes. The results reveal that all *Coccocarpia* thalli have *Rhizonema* cyanobionts and that many species house their own unique cyanobiont genotypes. New Caledonia and Kenya do not appear to have any symbiont genotypes in common. Symbiont diversity is closely linked to several crucial ecological processes, such as dispersal and establishment. Both temperate and tropical cyanolichen species can be used as biomonitors to effectively identify forest stands that are of highest priority in habitat conservation.

27. Light-driven host-symbiont interactions under hosts range shift caused by global warming

Tanja Jylänki (University of Oulu), Markkola, Annamari (University of Oulu), Kari Saikkonen (Natural Resources Institute Finland), Karita Saravesi (University of Oulu), Otso Suominen (University of Turku, Kevo Subarctic research institut), Erja Taulavuori (University of Oulu), Kari Taulavuori (University of Oulu)

In our study we highlight the importance of light environment in plant range shifts under conditions of global warming. The northern light environment may significantly modify competition between plant species and within ecotypes. Southern ecotypes of forest trees migrating northward will encounter both changed light quality and a different photoperiod. Our experimental design simulates range shift conditions in terms of light quality and temperature elevation due to global warming and compare reaction norms in key traits between southern

and northern ecotypes and species. This is achieved by isolated chambers where the air temperature is measured and controlled via real-time wireless online connection between northern (Kevo 69.75 °N) and southern (Jokioinen 60°N) study site. The aims are to study performance of southern and northern ecotypes of selected tree species *Betula pendula*, *Picea abies*, *Pinus sylvestris* and *Sorbus aucuparia* and their mycorrhizal symbionts in the northern light conditions in their future range alleviated by warming climate. Further, we exemplify how data obtained from experimental studies may be used for modelling of host plant and symbiont growth, which may in turn affect species competitive ability and distribution. We will especially focus on carbon economy and biomass partitioning between the autotrophic hosts and heterotrophic ectomycorrhizal fungal (EMF) symbionts, reciprocally dependent on each other. This applies also to the level of fungal community structure, which is assumed to be determined in part by host carbon economy. In this poster we will present our experimental design and practical implementation as well as some preliminary results from our study.

28. Genotype diversity and selectivity of Nostoc symbiont in lichen-forming Ascomycota (*Peltigera*) in hemiboreal region

Inga Jürriado (University of Helsinki), Ulla Kaasalainen (University of Helsinki), Maarit Jylhä (University of Helsinki), Jouko Rikkinen (University of Helsinki)

The widespread lichen genus *Peltigera* (Peltigeraceae, lichenized Ascomycota) includes mainly terricolous and muscicolous species and many of them are poorly delimited and/or undescribed. Internal Transcribed Spacer (ITS) sequences of fungal symbiont and tRNA^{Leu} (UAA) intron sequences of *Nostoc* cyanobiont were amplified from a total of 270 *Peltigera* specimens sampled from different grassland and forest types in Estonia. Phylogenetic analyses of ITS sequences grouped the specimens into five main lineages, and revealed considerable previously unrecognized diversity especially within the *P. canina* group. Some *Peltigera* taxa associate with a single *Nostoc* genotype, others are generalists, being able to associate with a spectrum of different *Nostoc* genotypes. However, this selectivity does not reflect the distinct phylogenetic relationships within the genus *Peltigera*; instead it correlates with mycobiont habitat preference. Habitat-specific segregation of *Peltigera* taxa and symbiotic *Nostoc* genotypes vary along gradients of (1) humidity, from mesotrophic forests to oligotrophic forests and grasslands and (2) soil pH: from alvar grasslands to other xerophytic habitats with acidic soil.

29. Cyanolichen guilds in montane cloud forests of East Africa

Ulla Kaasalainen (University of Helsinki), Veera Tuovinen (University of Helsinki), Jouko Rikkinen (University of Helsinki)

Lichen-forming fungi tend to be highly specific in their choice of symbiotic cyanobacteria. As local availability of compatible cyanobionts may influence the establishment success of fungal spores it has been suggested that photobiont-mediated guilds involving several different fungal species associating with the same photobiont may mutually improve the reproductive success of the whole symbiotic consortium. We studied fungal-cyanobacterial association patterns of cyanolichens in tropical montane forests of Taita Hills, Kenya. Symbionts were identified from approximately 450 lichen thalli, including several different genera of Ascomycota that associate with either *Nostoc* or *Rhizonema* cyanobionts. The results revealed extensive diversity in both partners of symbiosis, and widespread sharing of specific cyanobiont genotypes between different fungal species, genera and even families. A majority of studied mycobionts took part in photobiont-mediated guilds, centered on shared cyanobiont genotypes. The superficially invisible guild structure has important implications for lichen community ecology and offers valuable insights into symbiotic processes that influence the evolution of lichens.

30. Existing wine-growing conditions in Southern Finland and impact of climate change on it

Juha Karvonen (Department of Agricultural Sciences, University of Helsinki)

Climate conditions for grapevine growth are limited geographically. The aim of this study was to investigate the existing wine growing conditions in Southern Finland and impact of future climate change on them. The data was obtained from four locations: Tuusula (Helsinki region, Finland), Neubrandenburg (Mecklenburg-Vorpommern region, Germany), Freyburg (Saale-Unstrut region, Germany), and Herrlisheim-prés-Colmar (Alsace region, France). The air and soil temperatures at the planting depth as well as the rainfall were monitored during 2014–2016, from September to September. Based on climate scenario RCP2.6 (Representative Concentration Pathways), it was estimated how the viticulture conditions in Tuusula would change with the climate warming by 2°C by the end of the year 2100. Moving from Tuusula to Herrlisheim-prés-Colmar, the annual mean air temperature increased by over 5°C, but the annual soil temperature at the planting depth of 40 cm increased less than 5°C. The soil temperatures in any locations did not fall below 0°C at the planting depth in winters, i.e. the danger of root freezing is low even at the high latitudes. The predicted 2°C temperature increase would bring the spring, summer and early autumn temperatures in Helsinki Region close to Freyburg temperatures, which means that the growing season in Tuusula could begin at the end of March, i.e. 3 to 4 weeks earlier than present, which would suffice for *Vitis vinifera* L. varieties than today.

31. Subarctic and subalpine *Festuca rubra* s.l. are locally adapted to tree-line habitats, no thanks to fungal endophyte *Epichloë festucae*

Miia Kauppinen (University of Oulu), Mikko Sillanpää (University of Oulu), Juha Tuomi (University of Oulu), Bernhard Schmid (University of Zurich), Adrian Leuchtman (ETH Zurich), Piippa Wäli (University of Oulu)

Subarctic and subalpine ecosystems are vulnerable to climate change, especially so in the tree line ecotones, which are suggested to be particularly responsive to even slight environmental changes. Therefore, estimating the adaptive potential of plants species of such areas is essential for determining their future viability. Furthermore, beneficial symbionts of plants have been suggested to be important for plants in adapting to a particular environment. We used reciprocal transplantations among subarctic and subalpine treeline habitats to look for evidence of local adaptation of *Festuca rubra* to their native subarctic and subalpine environments. We also explored whether the endophytic fungus *Epichloë festucae* affects the performance of *F. rubra*, and especially, does *E. festucae* contribute the host's ability to adjust to native and/or foreign habitats. Our results show clear evidence that subarctic and subalpine *F. rubra* performed overall better in their sites of origin compared to the foreign plants, suggesting that the grasses are locally adapted to their native environments. This was especially evident in reproduction of the grasses. Though, subalpine *F. rubra* plants performed well with regards to vegetative traits also in the subarctic habitat, suggesting that they are more versatile than the subarctic plants regarding growth requirements. We also found that *E. festucae* does not generally contribute to adaptation of the host in local or foreign habitats. However, benefits for the host in the association with *E. festucae* were depended on plant origin and target country, indicating that associations among this fungus and grass are context dependent. Notably, beneficial endophyte-induced effects on the host appeared to vary with the life stage of the grass.

32. Learned parasite avoidance is driven by host personality and resistance

Ines Klemme (University of Jyväskylä), Anssi Karvonen (University of Jyväskylä)

Cognitive abilities related to the assessment of risk improve survival. While earlier studies have examined the ability of animals to learn avoiding predators, learned parasite avoidance has received little interest. Using the parasitic eye fluke *Diplostomum pseudospathaceum* and its intermediate fish host in a series of behavioural trials, we show that sea trout (*Salmo trutta trutta*) can learn to avoid colour cues associated with infection risk, and show a positive relationship between the personality trait boldness and the capacity to learn avoidance, suggesting that risky life-styles are compensated through an increased investment in cognitive abilities.

However, hosts ceased to use their acquired cognitive skills when immune responses became activated, suggesting that resistance to infection outweighs avoidance. Our results show that parasitism can be an important selective factor in the evolution of animal cognition, but cognitive skills can also be masked by other defence mechanisms.

33. Habitat use of coexisting vole species under competition and predation risk

Elina Koivisto (University of Turku), Katrine S. Hoset (University of Turku), Otso Huitu (Natural Resources Institute Finland), Erkki Korpimäki (University of Turku)

Competing species and predators can alter the habitat use of animals but both factors are rarely simultaneously controlled for. We studied in experimental enclosures how closely related species, the sibling vole (*Microtus levis*) and the field vole (*M. agrestis*), adjust their habitat use when facing either the competing species or simultaneously competition and predation risk. The species responded differently in their proportional use of two habitat types, a low cover (productive but riskier) and a high cover (safer but poorer). Field voles shifted more pronouncedly to high cover in mixed-species enclosures than when with conspecifics only and always decreased their use of low cover with increasing vole density. Sibling voles used the low cover more in the presence of field voles than under intraspecific competition. They did not respond to increasing population density in single-species populations, but decreased the use of low cover habitat in mixed populations. Sibling voles also responded to predation risk by increasing the use of high cover, whereas field voles, primarily utilizing high cover to begin with, did not change their behaviour. Our results highlight the importance of considering effects of both predation risk and interspecific competition when interpreting patterns of habitat selection among coexisting species.

34. Social support during conflicts in free-flying jackdaws

Robin Kubitz (University of Turku, Finland), Christine Schwab (University of Vienna, Austria)

Resolution of intra-group conflicts is a prerequisite for maintaining internal stability and cohesiveness in social groups. This may take the form of social support in which bystanders intervene into dyadic (or polyadic) conflicts on behalf of a social ally. Yet, outside various primate taxa studies investigating patterns and functions of social support are sparse. Here, we analysed long-term data on social interactions and support during conflicts in a social corvid, the jackdaw (*Corvus monedula*), to determine (a) whether birds are able to win conflicts more frequently when bystanders intervene on their behalf, (b) what factors influence the outcome of social support and of unsupported dyadic conflicts, respectively, and (c) whether sexes differ in patterns of providing social support. We found that birds had greater chances of winning a conflict when they received social support. Social support was more likely successful if it was provided actively and aggressively, and if the recipient of support was the aggressor of the prior conflict rather than the victim. Conversely, sex (male), pairing status (paired), high dominance rank and high agonistic outdegree (directing aggression frequently towards several conspecifics) were the factors leading to success in unsupported conflicts. Females played a more prominent role during conflict situations than previously thought: they intervened readily into ongoing conflicts on behalf of their mate. Males, conversely, did not selectively support their mates but supported also other group members when the risk of losing was low. We argue that females likely take certain risks in supporting their mate during conflicts in exchange for later male investment in offspring provisioning. Additionally, females benefit indirectly from their mate's social position; hence, they may be motivated in securing it. Male jackdaws may engage strategically in conflicts with other group members in order to solidify their position within the group.

35. The attitudes and acceptance of urban residents towards biodiverse, meadow-like lawns in Turku, Finland

Jussi Lampinen (University of Turku), Maria Tuomi (University of Turku)

Urban greenspaces are a source of recreation and personal nature experiences for a growing proportion of the world's population. However, urban densification threatens to diminish the area of available greenspaces, calling for the remaining greenspaces to be managed so, that they maximize benefits to both biodiversity conservation and recreation. One of the most common urban greenspaces are regularly mown lawns, with high maintenance costs and low species diversity. Emblematic to urban landscapes, lawns host a variety of aesthetic, intrinsic and instrumental values. Converting a part of the lawns into less intensively managed, tall-growing meadow-lawns could help conserve biodiversity in urban areas. However, trade-offs likely exist between different uses of the lawns, potentially contributing to lack of acceptance and objection towards new ways of lawn management. Understanding the attitudes and acceptance of urban residents towards meadow-lawns is a key prerequisite for altering the management of urban lawns. We interviewed 102 urban residents in Turku, Finland, and assessed their attitudes towards meadow-lawns using a face-to-face questionnaire with pictures of different management regimes. The study is a part of a European interview study spanning 16 cities in 8 countries, aiming to determine how acceptable meadow-lawns are according to urban residents and which factors explain the variation in this acceptance. Preliminary results from Turku indicate that many urban residents have positive views on increasing the proportion of meadow-lawns in the city, but would locate them somewhere out of the city center. Positivity towards meadow-lawns increased with a higher level of education, higher awareness of biodiversity and higher number of activities performed in urban parks. No difference in positivity was found between genders or housing location within the city. The results have implications for greenspace planning and nature conservation in urban areas.

36. Evidence for parallel antipredator armature reduction in multiple spring populations of the [relict] amphipod crustacean *Pallaseopsis quadrispinosa*

John Loehr (Lammi Biological Station, University of Helsinki), Risto Väinölä (LUOMUS, University of Helsinki), Mikko Immonen (University of Helsinki), Janne Sundell (Lammi Biological Station, University of Helsinki)

In 1958, the Finnish ecologist Sven Segerstråle described a remarkable spring population of the amphipod *Pallaseopsis quadrispinosa* that had reduced antipredator armature compared to lake populations. While Segerstråle felt that the system presented an 'unusually favourable opportunity for genetic experiments', little further research has been undertaken. Since 1958, three more spring populations have been discovered in Finland, providing the opportunity to test hypotheses about the reduction of armature (dorsal spines and supramarginal processes) in multiple populations. Analysis of mtDNA CO1 sequences shows that the spring populations have evolved in isolation from each other and from their neighbouring lake populations since deglaciation, and are now fixed for different haplogroups. Dorsal spines and supramarginal processes were absent or less developed in spring populations compared to adjacent lake populations. These differences in armature could not be explained by calcium availability in springs and lakes. In a laboratory breeding experiment, hybrid Spring X Lake F1 offspring had intermediate development of armature when compared to offspring of Lake X Lake and Spring X Spring matings. Armature traits were sexually dimorphic both in spring and lake populations, with more developed armature in males. The results support the hypothesis that armature reduction has independently evolved on multiple occasions in *P. quadrispinosa* and provide a glimpse into the processes of morphological evolution in an amphipod originating from Lake Baikal; a lake which has produced a vast number of endemic amphipod species.

37. Field realistic exposure to imidacloprid reduces foraging motivation of *Bombus terrestris*

Juho Lämsä (University of Oulu), Juha Tuomi (University of Oulu), Erno Kuusela (University of Oulu), Sini Juntunen (University of Oulu), Phillip Watts (University of Oulu)

Neonicotinoids, such as imidacloprid, are the most common class of insecticides and often linked to the diminishing populations of wild bees. In this factorial experiment we studied the effects of chronic sublethal doses of imidacloprid on bumblebee (*Bombus terrestris*) learning and foraging abilities. We fed the bumblebees with sugar solution containing 1 ¼g/kg of imidacloprid for one week, after which we started conducting behavioral trials that included both discrimination learning and foraging efficiency in a novel environment for the bees. The data consists of three treatment nests and three control nests, 159 individual bees in total. The experiment was carried out in laboratory conditions using automatized, computer controlled artificial flowers having either sugar solution or bitter quinine solution depending on symbols. The learning abilities were not affected by the pesticide treatment. However, the bees made fewer visitations to the artificial flowers, started foraging later and ignored the rarest flower type more often than bees in the control group. These results indicate that even very low sublethal concentrations of neonicotinoids can affect bumblebee foraging behavior, and possibly, have detrimental effect for the food intake and queen production of the bumblebee colonies. Similar concentrations of imidacloprid (1 ¼g/kg) are commonly measured from honeybee wax in the agricultural regions of France and the USA, where the decline of bees is a serious problem.

38. Recent climate trends and long-term vegetation changes in treeless heath communities in Northern Fennoscandia

Tuija Maliniemi (University of Oulu), Jutta Kapfer (NIBIO, Norwegian Institute for Bioeconomy Research), Patrick Saccone (University of Oulu), Anu Skog (University of Oulu), Risto Virtanen (Helmholtz-Zentrum für Umweltforschung, Germany)

Recent climate trends towards warmer and moister conditions are having strong effects on sensitive vegetation of boreal, arctic and alpine ecosystems. It is generally expected that these new climate conditions become reflected in corresponding vegetation changes including latitudinal and altitudinal upward shifts of species and increase of shrub abundance and biomass. However, evidence from observational long-term studies of vegetation changes in these ecosystems is still rare. The aim of our study was to explore decadal time scale vegetation changes in northern boreal heaths and hemiarctic mountain tundra heaths in northern Fennoscandia and relate these changes to changes in climate. Vegetation changes were also studied along snow-cover gradient. Long-term climate records from study area are in line with recent climate trends, although some regional variation exists. Thus, regionally non-uniform vegetation changes could be expected. The study was conducted by relocating and resampling 111 non-permanent vegetation plots that were originally sampled 60 years ago. To detect changes in plant community composition, species abundance and species richness the old and the new data were compared. Results show shift of northern boreal heaths towards moisture preferring communities, likely reflecting increased summer temperature and precipitation. In mountain tundra, the community composition of snow protected heaths has shifted considerably towards wind exposed heath communities that showed no long-term changes. Substantial change of snow protected plant communities is probably due to earlier snowmelt. We didn't find notable increase of southern or forest species anywhere or increase of tall shrubs. However, the cover of *Empetrum hermaphroditum* has increased significantly in most sites. Our results suggest vegetation responses to changing climate and that northern boreal heaths and snow-protected tundra heaths are most vulnerable to changes under current climate warming.

39. Herbivore - plant - microbes associations in a natural ecosystem

Guillaume Minard (University of Helsinki), Gleb Tikhonov (University of Helsinki), Otso Ovaskainen (University of Helsinki), Marjo Saastamoinen (University of Helsinki)

Bacterial symbionts are interacting with multicellular eukaryotic organisms with a gradient ranging from parasitism to mutualism. Those interactions results in a wide range of effects on their host's life history and may participate directly or indirectly to their population dynamics. The Glanville fritillary butterfly *Melitaea cinxia* is one of the most documented insect model in population ecology. The long term study of its metapopulation

in the Åland islands has described an extinction - recolonization pattern of the butterfly in the fragmented environment. Part of the biotic and abiotic factors responsible for this dynamics are well understood. However, the bacterial microbiota of *M. cinxia* has been poorly investigated until now. In order to describe how the microbiota varies within and among natural populations, we sampled 190 individuals of 5th instar larvae as well as leaf samples of their host plant *Plantago lanceolata* from 15 patches in the region of Sund in the Åland islands. The integrated study of *M. cinxia* midgut bacterial composition, variation in the population network, the impact of parasitoid infection and the host plant quality (microbiota and metabolites intake) was investigated. Interestingly, the larvae presented a poor bacterial community structure at the family and the population levels. This pattern was explained by a high inter-individual heterogeneity of the microbiota community, which contrasted with the homogeneity of the bacterial communities colonizing the host plant. However, the infection of the larvae with the specialist parasitoid *Hyposoter horticola* was associated with an enrichment of the microbiota by bacterial taxa belonging to the Enterobacteriaceae family. Our result offer an unexpected example contradicting the paradigm of how food and genetic background shape the microbiota communities of animals.

40. Long-term changes and the effects of thinning and climate trends on boreal forest understory vegetation

Lauralotta Muurinen (Dept. Ecology and Genetics, Univ. Oulu), Ilkka Vanha-Majamaa (Natural Resources Institute Finland, Vantaa), Jari Oksanen (Dept. Ecology and Genetics, Univ. Oulu), Risto Virtanen (Dept. Ecology and Genetics, Univ. Oulu)

Over 90% of the forested area in Finland is used for forestry, which has led to changes in forest communities and altered ecosystems. Simultaneously, boreal forests are expected to be extremely vulnerable to global change. How to maintain and protect forest biota is one of the key questions in Finnish nature conservation and forest management. Understory vegetation is important in maintaining other biota, biodiversity and ecosystem processes. Thus, better understanding about long-term changes in forest vegetation is needed. In this study we investigate (1) how multiple thinning treatments have altered successional development of understory in mesic heath forest planted by pine during 60 yrs., (2) what are the long-term effects of thinnings on community dynamics, and (3) how changes in climate are reflected in understory vegetation. We used systematically sampled vegetation plot data (years 1961, 1987, 2013) from a forest thinning experiment at Kaihuanvaara (Rovaniemi, northern Finland). During the study period succession had proceeded and there were significant changes in understory communities. Multiple thinnings did not significantly alter the overall trends but the shifts in community structure were stronger in sites thinned multiple times. However, understory alpha diversity did not significantly change during the study period nor differed between treatments. Probably due understory communities are typically dominated by generalist species that are adapted to frequent disturbances, have large regional species pool and can maintain their populations throughout succession. However, some species and species groups showed stronger responses than others. A clear trend to understory humidification was also detected. According to these long-term results, boreal forest understory seems to be resistant and resilient to small forest thinning disturbances and able to recover, but an increase in disturbance frequency leads to higher instability in community dynamics.

41. Ecological and economic trade-offs of voluntary nature conservation

Eini Nieminen (University of Jyväskylä), Janne Kotiaho (University of Jyväskylä), Panu Halme (University of Jyväskylä)

Different types of voluntary nature conservation are becoming more popular worldwide. METSO-program has mainstreamed voluntary conservation also in Finland. First voluntary conservation was one measure among others, but in current Finnish policy voluntary conservation has gained more footholds and even replaced other means. At the same time resources for conservation have been cut significantly. In this research I will study, what are the biodiversity effects of voluntary conservation, and how much more the protection of certain

biodiversity values costs when implemented by voluntary means than by a law-based program. My hypothesis is that voluntary conservation fails to protect biodiversity with current conservation resources, because effective voluntary conservation may require more resources than law-based programs. This is likely because when landowners are allowed to refuse to protect their lands, some of the most valuable sites (that is, biodiversity hotspots) will stay outside legal protection. Corresponding biodiversity values cannot be protected simply by conserving the same amount of area from somewhere else, but instead by conserving larger area which is more expensive. I will study the questions by using Mire Conservation Program as a case study. By combining the survey data concerning landowners opinions of mire conservation and the biodiversity data gathered for the Program, I will analyse three conservation scenarios by conservation planning software Zonation: 1) The Mire Conservation Program will be implemented as a law-based program designed by conservation experts. 2) The Program will be implemented by same resources than in the first scenario, but landowners are allowed to refuse from protection of their lands. 3) The Program will be implemented allowing refusing, but without budget limits and not sacrificing the biodiversity values which the law-based program would bring about.

42. Inbreeding depression interacts with landscape structure to affect the persistence of metapopulations

Etsuko Nonaka (University of Helsinki and Lund University), Toby Fountain (Uppsala University), Lasse Ruokolainen (University of Helsinki), Otso Ovaskainen (University of Helsinki), Ilkka Hanski (University of Helsinki)

Landscape structure is an important determinant of the sizes and connectivity of spatially structured populations. Many demographic and evolutionary processes are influenced by spatial structure of populations, including extinction, colonization, gene flow, and genetic drift. Inbreeding may increase in frequency in landscapes characterized by small, less connected populations, which may potentially decrease population persistence at the metapopulation scale. Previous empirical studies have shown that inbreeding can negatively impact fitness of individuals (i.e., inbreeding depression) and can increase extinction risk of small populations. Proneness to extinction of metapopulations likely depends on landscape structure especially when a metapopulation persists by extinction and colonization dynamics. The objective of this study is to scale up the effects of inbreeding depression at the individual and local population levels to the metapopulation scale and to examine the effects of landscape structure on the frequency of inbreeding, genetic diversity, and metapopulation persistence. We developed a genetically explicit individual-based model of a metapopulation parameterized with extensive data and knowledge available for the Glanville fritillary butterfly in the Åland islands. We applied this model to 15 semi-independent networks of habitat patches in a NE region of the mainland Åland. The results show that metapopulations living in networks with lower metapopulation capacity (i.e., more fragmented) are more negatively affected by inbreeding depression. The frequency of inbreeding is about four times higher in smaller networks, but substantial inbreeding occurred even in the networks with highest metapopulation capacities. In summary, inbreeding is more frequent in smaller, less connected networks, and extinction risk of entire metapopulations living in such networks may be elevated due to frequent inbreeding and associated inbreeding depression.

43. Resource pulse induced community assembly of wood-inhabiting fungi

Anna Norberg (University of Helsinki), Otso Ovaskainen (University of Helsinki), Janne S. Kotiaho (University of Jyväskylä), Tero Toivanen (University of Jyväskylä), Panu Halme (University of Jyväskylä)

As the spatial and temporal variability of resources are generally considered to be important factors affecting the dynamics of natural systems, it is both evident as well as well-documented that rare but large-magnitude additions to resource availability, i.e. resource pulses are ecologically significant events with wide effects. Some possible persistent effects come through changes in community structure, such as alternative stable states, or long-lasting transient effects of the community. A key factor affecting the states of communities is their assembly history, and moreover the priority effects it brings about. Priority effects are the influence of an

occupying species on the probability of establishment of following colonisers. Pulsed accumulation of dead wood is a natural part of boreal forest ecology. Occasionally, due to e.g. particularly stormy winds or wide insect outbreaks, a large amount of dead wood is produced during a relatively short amount of time. Wood-inhabiting fungi provide a convenient group for studying the effects of a resource pulse as these events are relevant for their natural dynamics, the amount of resources available for the species can be quantified, they are immobile, and their occurrences can be linked to a particular resource unit. Moreover, wood-inhabiting fungi are ideal also for studies of assembly history and priority effects, as some species are well known to colonise their substrates earlier than others, but there is stochastic variation in the timing of species immigration and the interactions between species that remains unexplained. In this replicated and controlled experiment, we manipulated the amount and spatial distribution of dead wood and studied the polypore species assembly over an eleven-year period after the resource manipulation, and investigate the effects of assembly history especially priority effects on the resource-pulse induced community development of wood inhabiting fungi.

44. Landscape promotes persisting diversity of a wild plant pathogen

Elina Numminen (Univ. of Helsinki), Anna-Liisa Laine (Univ. of Helsinki)

The availability and dynamics of host population is the key driver of the ecological and evolutionary dynamics of pathogen populations. In our study, a densely sampled longitudinal genomic dataset is analyzed in order to assess the features driving spatio-temporal diversity and transmission dynamics of an obligate plant pathogen, *Podosphaera plantaginis*. Statistical analyses reveal the stationarity of the pathogen population. We find that new strains emerge in the closed system at a constant rate. The strains exhibit ecologically neutral dynamics, and there is a considerable stochastic turnover of pathogen strains in most of the habitats. However, at the landscape level, groups of host populations that are well connected to each other among which transmission should be favored- jointly represent a constant source of new pathogen strains. In those populations, different pathogen strains are present in close proximity, and the local extinctions are less frequent so that the local diversity is also sustained for longer, allowing for more possibilities for outcrossing and between-patch dispersal.

45. Grazers increase beta diversity of vascular plants and bryophytes in wood-pastures

Anna Oldén (University of Jyväskylä), Panu Halme (University of Jyväskylä)

Grazed wood-pastures host high plant diversity, but why? We studied the effects of grazers on plant species richness as well as on beta diversity and its two components, species turnover and nestedness. The effects of various grazer activities (defoliation, trampling and defecating) on plant beta diversity were also studied. The study was performed in 24 currently grazed and 24 abandoned wood-pasture sites in Central Finland. The species richness of vascular plants and bryophytes was studied at four spatial scales: within 4m² subplots, within 100m² plots, within sites and within the landscape. Beta diversity was studied between subplots within plots, between plots within sites, and between sites within the landscape. We found that grazing creates and maintains high species richness of vascular plants and bryophytes at all spatial scales. Within grazed sites plant beta diversity is high, mostly due to high species turnover between patches. Defoliation, defecating and trampling are all important turnover agents although their relative importance varies with spatial scale. At the landscape scale the currently grazed sites had high species turnover between them and thus the conservation of all grazing-dependent species requires continued management at various sites, while high nestedness between abandoned sites implies that their biodiversity can be efficiently conserved by protecting the most species-rich sites.

46. Predicting the abundance and occupancy of stream organisms at high latitudes: the roles of niche position, niche breadth and body size

Mariana Perez Rocha (Finnish Environment Institute, University of Oulu), Luis Mauricio Bini (Universidade Federal de Goiás, Brazil), Tadeu Siqueira (Universidade Estadual Paulista, Brazil), Mira Grönroos (University of Helsinki), Marja Lindholm (University of Oulu), Satu-Maaria Karjalainen (Finnish Environment Institute), Jani Heino (Finnish Environment Institute, University of Oulu)

A positive relationship between occupancy and abundance of species has been widely described for various groups of organisms. Also, it has been observed to occur on different scales, ranging from broad biogeographic regions to small areas within a drainage basin. The influence of body size (BS) on species distribution can also differ between different organismal groups, and the occupancy and abundance of species can be strongly affected by their BS, niche breadth (NB) and niche position (NP) in combination. Consequently, this suggests a relationship between BS and the degree of occupancy at large spatial scales, but also that variations exist with regard to the organism group under study. Also, patterns of geographic distribution may not remain the same within smaller regions, where species occupancies may or may not be related to BS. Here, we analyzed stream diatom and insect species data from the Tenojoki drainage basin (70oN). We hypothesized that potential links between regional occupancy, local abundance, NB, NP and BS of species vary between diatoms and insects. We expected differences in the relationship between regional occupancy or local abundance and BS between the two organismal groups. Our results showed a very strong positive occupancy-abundance relationship in both stream diatoms and insects, showing niche-based processes as the main causes of variation in regional occupancy and mean local abundance of species. This was mainly due to local environmental NP measures, whereas NB hypothesis could almost be rejected. However, we detected the effect of BS only on mean local abundance of diatoms species, whereas NP and NB generated by catchment variables were also significant predictors of insect occupancy. Our present findings thus add considerably to the discussion of the occupancy-abundance relationship in rarely-studied organisms in near-pristine aquatic environments.

47. Continuous cover forestry as a cost-efficient tool to increase multifunctionality of boreal production forests

Maiju Peura (University of Jyväskylä), Daniel Burgas (University of Jyväskylä), Kyle Eyvindson (University of Jyväskylä), Anna Repo (University of Jyväskylä), Mikko Mönkkönen (University of Jyväskylä)

Diversifying silvicultural practices may be a cost-efficient tool to ensure multifunctionality in production forests. Our study compared the effects of continuous cover forestry and conventional rotation forestry on provisioning, regulating and cultural services as well as on biodiversity indicators and landscape multifunctionality in boreal forests in Finland. We simulated slightly over 30,000 of commercial forest stands for 100 years under continuous cover and rotation forest managements. To estimate the relative performance of practices, unmanaged forests were used as a benchmark. Results revealed that continuous cover forestry was better than rotation forestry for 5 of 8 ecosystem services and for 6 of 8 biodiversity indicators. Multifunctionality was higher in continuous cover forests having a greater potential to produce simultaneously multiple benefits. Nevertheless, the combination of these two silvicultural practices provided higher values of different objectives than consistent application of either of the practices, which highlights the role of landscape level planning. Moreover, unmanaged forests often provided the highest levels of services and biodiversity making their role indispensable. Continuous cover forestry does not itself resolve the problem of the decline of all ecosystem services and biodiversity in production forests but it can be an essential part of the solution towards more sustainable forestry.

48. Epiphytic bryophytes respond to changes in forest structure in Peruvian cloud forests

Tinja Pitkämäki (University of Turku), Johanna Toivonen (University of Turku), Sanna Huttunen (University of Turku, Herbarium)

Increasing human impact threatens the forest biota of tropical Andes. The loss and degradation of forest habitat has been most dramatic in cloud forests (CFs). Yet exceptional biodiversity and valuable ecosystem services provided make CFs a priority target for conservation. High epiphyte loads in CFs constitute a water storage that buffers the ecosystem against hydrological extremes: floods and drought. In particular, epiphytic bryophytes efficiently absorb water from fog (horizontal interception) and release it during drier periods. Many authors report a positive relationship between canopy water retention capacity and epiphyte biomass. My PhD research adds a taxonomic component, which allows for more detailed examination of diversity effects on ecological function. Research consists of two parts: 1. describing the relationships between environmental variables and community composition of epiphytic bryophytes, and 2. resolving the effect of community composition on ecohydrological processes. The first study considered the anthropogenic impacts on epiphytic bryophytes. Based on a vegetation survey in primary and secondary cloud forests of Northern Peru, tree density and basal area are good indicators of the degree of human disturbance. The biomass of epiphytic bryophytes decreases as the forests become more disturbed. Associated changes in the community composition suggest that bryophytes respond to altered microclimatic conditions following logging. Results are presented for both taxonomic diversity and growth-form based functional diversity.

49. More is more? Forest management allocation at different spatial scales to mitigate conflicts between ecosystem services

Tähti Pohjanmies (University of Jyväskylä), Kyle Eyvindson (University of Jyväskylä), María Triviño (University of Jyväskylä), Mikko Mönkkönen (University of Jyväskylä)

Conflicting interests regarding land and natural resource use present a challenge for land managers. Multiobjective optimization tools can be used to allocate land-use types across a landscape in order to mitigate the conflicts, e.g. to identify sites where a single objective should be prioritized and sites where several objectives can be targeted simultaneously. The variation in features relevant to the objectives within the target landscape affects the utility of such an exercise, and this variation is, in turn, a result of the extent and delineation of the target area. In this study, we aimed to reconcile two conflicting objectives, timber production and carbon storage, by optimizing the allocation of management strategies in forest areas in Finland. We performed the optimization analysis within four hierarchical spatial scales small forest holdings, large forest holdings, watersheds, and region and compared the outcomes to test for the effect of the target area's extent on the perceived severity of the conflict and the potential for solving it efficiently. We found the results from the smallest scale to differ from the three larger scales, while the differences among the three larger scales were negligible. The largest improvements from increasing the scale of the target area could be gained when one of the objectives was required to be at a near-maximal level, while at intermediate levels the improvements were comparatively small. Our results 1) show that there are clear benefits to considering an area beyond a few stands in forest management planning, and 2) suggest that the scale of large forest holding, consisting of approximately 100 stands, is large enough to mitigate the conflict between timber production and carbon storage efficiently. The majority of production forests in Finland are in comparatively small holdings. Our results are thus encouraging for real-world implementation of multiobjective optimization tools in forest management planning.

50. Population census of the white-tailed deer using camera trapping and DNA methods

Jenni Poutanen (Turun yliopisto), Jon Brommer (Turun yliopisto)

In Finland, the white-tailed deer is an important game species but we are still lacking proper methods to census it. Thus, we do not have a good information on the composition of the populations, which would be necessary to know when developing game management plans. Here, I aim to develop accurate census methods for the white-tailed deer by using non-invasive tools: DNA methods and wildlife camera trapping. Based on the DNA extracted from fecal samples or the pictures of cameras, different individuals can be identified. Obtained individual encounter history data is then analyzed with Spatial Capture Recapture (SCR) methods, which utilize

the spatial information of captures (when and where) to estimate the density. First, we developed a study design to collect white-tailed deer fecal samples. 47 sampling clusters each containing four sampling plots were placed on the field in a grid array. Clusters were 500 m and plots 100 m apart from each other. During a four week period each site was visited once in a week. About 450 fecal samples were collected during the whole period. 164 samples have been genotyped with microsatellites with 15 % genotyping success rate and 18 different individuals identified. Preliminary results with SCR suggested that the white-tailed deer density in the study area was 34 individuals / 1000 ha (CRI 18.8 - 48.8). In the next phase, DNA sampling is compared with camera trapping. 36 wildlife cameras and 23 sampling plots were placed on the field in a grid array similar than previously. During the three week sampling season about 550 fecal samples were collected and about 5200 of the camera pictures contained white-tailed deer. From the pictures, males can be identified based on their antler shape and possibly fawns on their fur spots, but females remain unidentified. SCR methods can be applied in this kind of data containing the individual encounter histories and the occupation data including unidentified individuals.

51. ESEB 2019 in Turku: a call for volunteers

Craig Primmer (University of Turku)

The European Society Evolutionary Biology bi-annual conference is one of the largest biology-related conferences in Europe, routinely attracting 1500 attendees. Despite high attendance by Finns over the years, the conference has never been held in Finland. That will change in 2019, when ESEB will be held at the Logomo Convention Centre in Turku from August 19-23 2019. Organizing such a large conference successfully is not possible without contributions from a broad range of volunteers and in the coming months I will be looking for Finland-based evolutionary biologists willing to help on various committees, such as: scientific, diversity, outreach and publicity, sponsorship, local experiences, with a view to having the committees established and rolling before ESEB 2017 this coming August. This poster will present details of the timeline for various organization deadlines, as well as a link to a form where you can indicate which tasks you would be willing to volunteer for. The link is also below, so actually, you don't need to go and see the poster really, but there will be some nice photos of Turku (including the cool conference dinner location). Also feel free to chat to me or email about any specific ideas/innovations you have. In particular, as space for poster boards is limited, ideas for novel alternatives to posters are particularly appreciated. Link to the volunteering form: <https://link.webropolsurveys.com/S/049325E5BD55143B> Email: craig.primmer@utu.fi Twitter: @ESEB2019 #ESEB19

52. Parasite infection alters host stable-isotope composition under controlled feeding

Katja Pulkkinen (University of Jyväskylä), Sanni Aalto (University of Jyväskylä), Hannu Nykänen (University of Jyväskylä)

Stable isotopes are widely used for studying trophic relationships, but variation driven by environmental conditions or food availability complicates the interpretation of trophic dynamics. Parasites are ubiquitous and known to affect physiological functions of their hosts, but only few studies have assessed the effects of parasites on isotope composition of hosts. We measured the changes in two of the most commonly used stable isotopes in food-web studies, nitrogen (i.e. $^{15}\text{N}:\text{N}$ ratio; denoted as $\delta^{15}\text{N}$) and carbon ($^{13}\text{C}:\text{C}$; $\delta^{13}\text{C}$) in *Daphnia* hosts exposed to infection by a parasitic microsporidian in the laboratory. Isotopic signatures of hosts fed a standardized controlled diet were compared with uninfected animals under conditions of high food availability and under food limitation. Parasite infection led to enriched $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ values that were associated with decreased growth and decreased lipid content, indicating energy limitation comparable to that in food-limited animals. However, enrichment in $\delta^{13}\text{C}$ values was apparent sooner in infected well-fed animals than in the food-limited animals, suggesting strong parasite-induced effects on host C-metabolism. By using experimental exposure to parasite infection and a standardized diet, our study excluded the effects of changes in food sources

via parasite-induced altered habitat or feeding behavior on host isotope composition and demonstrated for the first time that parasite infection directly alters the isotopic values of the host. Our study demonstrates that parasite-induced changes in isotope values may add to the variability in the estimates of the contribution of each food type assimilated by consumers, and thus should be taken into account during investigations of trophic relationships and food webs.

53. The species richness and population sizes of wood-inhabiting fungi in an especially thoroughly studied forest implications for fungal conservation

Jenna Purhonen (University of Jyväskylä), Panu Halme (Jyväskylä University Museum), Emma-Liina Marjakangas (Norwegian University of Science and Technology), Abrego Nerea (Norwegian University of Science and Technology)

Species richness is the most common variable analyzed in community studies and population size is the basis of Red List evaluation. Therefore it is surprising that evaluations of fungal species richness are rarities, and no one has even tried to evaluate the population sizes of fungi in different habitats. As a consequence, fungal species richness estimates are commonly based on surrogates such as vascular plant species richness and fungal Red List evaluations are usually based on some other criteria than population size. In this study we utilize an extensive fruit body survey data, collected on wood-inhabiting fungi in one 108ha forest in Finland during a decade. The data is based on several different sampling methods, with the aim to detect different target species groups on certain logs or sample plots. We combine this data with a detailed dead wood profile based on 72 dead wood plots situated in the same forest. Based on these data we are able to estimate species richness and population sizes of wood-inhabiting fungi in this forest. We show that the effort has been adequate to detect majority of the local species pool, i.e. currently 504 species. We also show that the local population sizes of wood-inhabiting fungi can be very high and that two species with seemingly similar ecology can have massive variation in their local population size. High local population sizes may greatly change what we think to be an optimal conservation strategy.

54. Effects of glyphosate on oxidative status of a non-target herbivore, the Colorado potato beetle

Miia Rainio (University of Turku), Aigi Margus (University of Jyväskylä), Leena Lindström (University of Jyväskylä)

Glyphosate is the mostly used herbicide all over the world against a wide range of weeds. Glyphosate has been considered safe to animals as they mainly target physiological pathways in plants. However, the recent toxicological studies have revealed that glyphosate can cause various toxic effects also on animals. In this study, we investigated the direct toxic effects of glyphosate (using commercial product Roundup®) on 1) survival and 2) oxidative status of a non-target herbivore by using the Colorado potato beetles (*Leptinotarsa decemlineata*), originated from Poland and USA, as model species. The small larvae were randomly divided into three groups: 1) high concentration (100% Roundup Bio, 360g/l), 2) low concentration (1.5% Roundup Bio, 360g/l) and 3) control group (water). The treatment groups were treated with Roundup by pipetting it on a filter paper, placed on the bottom of a clean petri dish. The control group was treated similarly, but using water instead of glyphosate. The larvae were exposed to Roundup for different time periods: 2h, 24h, 48h, 72h and 96h, after which the larvae from each treatment group were checked for mortality. The larval survival decreased in the group treated with high concentration of glyphosate compared to controls, but low concentration group did not differ from the controls. Glyphosate treatment had no association on oxidative status biomarkers (including catalase, superoxide dismutase and glutathione-S-transferase as well as glutathione and enzymes related to glutathione metabolism), but increased the lipid peroxidation levels after 2h exposure, suggesting increased oxidative damage soon after the exposure. Populations also differed from each other in their oxidative status, indicating differences in their antioxidant defence system. Our results show that glyphosate can reduce the

survival and increase the oxidative damage of the herbivores, especially when exposed to high concentrations of glyphosate.

55. Social behavior and gut-microbiota in red-bellied lemurs (*Eulemur rubriventer*): In search of the role of immunity in the evolution of sociality.

Aura Raulo (University of Oxford), Lasse Ruokolainen (University of Helsinki), Ilkka Hanski (University of Helsinki), Avery Lane (University of Arizona), Katherine Amato (Northwestern University), Rob Knight (University of California San Diego), Steven Leigh (University of Illinois), Rebecca Stumpf (University of Illinois), Bryan White (University of Illinois), Karen Nelson (J. Craig. Venter Insitute), Andrea Baden (Hunter College, City University of New York), Stacey Tecot (University of Arizona)

Vertebrate gut-microbiota forms a key component of immunity and a dynamic link between an individual and the ecosystem. Microbiota might play a role in social systems as well, because they are transmitted during social contact and can affect host behavior. In addition, stress physiology can affect both social-behavior and microbiota. Combining methods from behavioral and molecular research, we describe the role of gut-microbiota in the social dynamics of a group-living cooperative primate, the red-bellied lemur (*Eulemur rubriventer*). Specifically, we ask whether patterns of social contact (group membership, group size, position in social network, individual sociality) and stress physiology are associated with patterns of gut-microbial composition between individuals and across time. Red-bellied lemurs were found to have a relatively temporally stable and strongly social group-specific gut-microbiota. Position within the social network predicted gut-microbial composition but contrary to expectations, individual sociality was negatively associated with gut-microbial diversity. The later association was possibly mediated by stress as glucocorticoid levels were found to be associated with a specific gut-microbial composition. These results emphasize the role of the social environment in determining microbiota of adult animals. Since social transmission of gut microbiota has the potential to enhance immunity, microbiota might have played an escalating role in the evolution of sociality.

56. Habitat selection of the mud crab *Rhithropanopeus harrisi* in its newly invaded range

Katariina Riipinen (University of Turku), Salla Mikkola (University of Turku), Milla Ahola (University of Helsinki), Milla Aalto (University of Turku), Alisa Olkinuora (University of Helsinki), Outi Vesakoski (University of Turku)

Information on the habitat selection of non-indigenous species is crucial for understanding their effects on the communities to which they are introduced, since the effects are often focused on the invaded habitats. The North American mud crab *Rhithropanopeus harrisi* is a new invader in the northern Baltic Sea, for example in Finland. In both its native and invasion range, it uses a variety of shelter-offering habitats. In the Finnish Archipelago Sea, it has been found in two very distinct habitats: reed belts of *Phragmites australis* and algal zones with bladderwrack *Fucus vesiculosus* as the main habitat-forming species. In previous studies, *R. harrisi* has preferred *F. vesiculosus* and has locally driven a shift in the community structure of *F. vesiculosus* habitat. Here, we disentangle whether the habitat choice is determined by habitat structure or the availability of food. We first conducted a habitat selection experiment with *P. australis* reed habitat and *F. vesiculosus* habitat with varying food availability, and found that *R. harrisi* preferred *F. vesiculosus* with food having no effect on the habitat choice. Second, we studied if the preference for *F. vesiculosus* was due to the alga itself or the rocks it grows on. Here, *R. harrisi* preferred the shelter of the rocky habitat, indicating that *R. harrisi* choose their habitat based on habitat structure. Therefore, *R. harrisi* may impact the communities of rocky bottom habitats as well as *F. vesiculosus* growing on them.

57. Frequency-dependent flight activity in the colour polymorphic wood tiger moth

Bibiana Rojas (U. Jyväskylä), Swanne Gordon (U. Jyväskylä), Johanna Mappes (U. Jyväskylä)

Predators effectively learn to avoid one type of warning signal rather than several. For this reason, warning signal polymorphisms are expected to be selected against. Aposematic wood tiger moth males (*Arctia plantaginis*) have either white or yellow hindwing coloration across Europe, with several populations being

polymorphic. Previous studies indicate that yellow males are better defended from predators, while white males have a positively frequency-dependent mating advantage. However, the potential frequency-dependent behavioural differences in flight between the morphs, as well as the role of male-male interactions in inducing flying activity, have not been previously considered. We ran an outdoor cage experiment where the frequencies of both male morphs were manipulated to test whether flying activity was frequency-dependent and differed between the two morphs. The white morph was significantly more active than the yellow one across all treatments, and sustained activity over longer stretches of time. Overall activity for both morphs was considerably lower in the yellow-biased environment, suggesting that higher proportions of yellow males in a population may lead to overall reduced flying activity. The activity of the yellow morph also followed a steeper, narrower curve than that of the white morph, which coincided with the peak of female calling activity. We suggest that white males, with their presumably less costly defences, have more resources to invest in flight for predator escape and finding mates. Yellow males, which are better protected but less sexually selected, may instead compensate their lower flight activity by flying smart during the peak female-calling periods. Thus, both morphs may be able to balance through their behaviour the trade-off between warning signal selection and sexual selection. Our results emphasise the greater need to investigate animal behaviour and colour polymorphisms in natural or semi-natural environments.

58. To starve or to strive - Larval responses to variation in plant quality

Elena Rosa (University of Helsinki), Luisa Woestmann (University of Helsinki), Marjo Saastamoinen (University of Helsinki)

The quality of host plants plays a critical role on the development of insect herbivores feeding on them, especially during early larval stages. For example, the composition of nutrients an herbivore can acquire from a host plant varies depending on whether the plant is healthy or sick. In addition, some plants produce secondary metabolites to deter herbivory-induced damage, and only specialist insects successfully feed on them, potentially with some costs. For example, plant secondary metabolites can even alter the investment in immune defenses of some insect hosts. We tested the effect of high and low production of plant secondary metabolites in presence or absence of a plant pathogen on the performance of a specialist larval herbivore. We used pre-diapause caterpillars of the Glanville fritillary butterfly (*Melitaea cinxia*) fed on different genotypes of the host plant *Plantago lanceolata*, which were selected for either high or low content of the secondary metabolites iridoid glycosides (IGs). Plants with high and low IGs were either healthy or infected with the fungal plant pathogen powdery mildew (*Podosphaera plantaginis*). We measured developmental traits of the larvae until diapause, as well as their investment in immunity with an assay of insect immunocompetence (phenoloxidase activity), and with qPCR on a suite of seven insect immune genes. We found that IGs content significantly shaped larval growth, with high IGs concentration promoting faster larval development and larger body mass in absence of powdery mildew infection, but also higher larval mortality. Mildew infection reduced larval body mass, but had no effect on larval survival. These and other preliminary data are discussed in the context of the ecology of the Glanville fritillary butterfly.

59. Experimental lead pollution alters DNA methylation patterns in a wild bird population

Suvi Ruuskanen (Department of Biology, University of Turku), Hannu Mäkinen (Department of Biology, University of Turku), Eeva Tapio (Department of Biology, University of Turku), Veronika Laine (Netherlands Institute of Ecology), Kees van Oers (Netherlands Institute of Ecology)

Epigenetic regulation of gene expression, such as DNA methylation, has attracted much interest in recent years. Studies in model organisms have showed that methylation patterns can be affected by various environmental factors, including pollutants and nutrition, but data from wild animal populations is largely lacking. We investigated the effects of early-life exposure to the heavy metal lead (Pb) on genome-wide DNA methylation status in a wild population of great tits (*Parus major*) by experimentally exposing nestlings to lead at

environmentally relevant levels. Secondly, we studied the heavy metal exposure in combination with an indirect effect of metal pollution, low quality and quantity of nutrition, on DNA methylation patterns by analyzing samples from nestlings from a population close to a pollution source, copper smelter. Several differentially methylated regions were identified between control and experimental groups, associated with various cellular processes and development. Interestingly, lead exposure caused hypermethylation whereas indirect pollution effects at the smelter site caused hypomethylation. Our study indicates that post-natal anthropogenic heavy metal exposure can affect DNA methylation in a wild population.

60. Context-dependent dispersal in a butterfly metapopulation: implications for predictive studies on functional connectivity

Susu Rytteri (University of Helsinki), Mikko Kuussaari (Finnish Environment Institute), Marjo Saastamoinen (University of Helsinki), Otso Ovaskainen (University of Helsinki)

Annual variations in environmental conditions, such as in prevailing type of weather, may cause inter-generation variation in the movement of univoltine organisms. Studies modelling dispersal rates in spatially structured (meta)populations and assessing functional connectivities of given landscapes have rarely considered the influence of varying weather conditions on dispersal patterns. In this study, we investigate the impact of weather and landscape structure on the dispersal predictions of a diffusion-based movement model parameterised with mark-recapture data on the threatened Clouded Apollo (*Parnassius mnemosyne*) butterfly. The model was parameterised separately based on data gathered in a warm and sunny flight season 2013 and a cold and rainy flight season 2014 in a metapopulation founded by a translocation in 2000. The spread of the butterfly in this forested translocation landscape is predicted using movement parameters from the source population inhabiting more open landscape. The unfavourable weather in 2014 led to a model predicting less between-patch movements than the more favourable weather in 2013, but the level of uncertainty in the predictions was relatively high. Our ongoing work on predicting the spread of butterflies in a novel landscape under varying weather conditions will bring further insight into this matter. Taking into account weather conditions, an issue largely neglected in previous modelling studies, may substantially increase realism in predictions of annual dispersal rates of ectotherms within and between suitable habitats and hence improve the understanding on the functional connectivities of different landscapes. This is of great importance in predicting the ecological effects of global climate change and halting the biodiversity loss it is causing.

61. Putting *Parasemia* in its phylogenetic place: a molecular analysis of the subtribe Arctiina

Katja Rönkä (University of Jyväskylä), Johanna Mappes (University of Jyväskylä), Lauri Kaila (University of Helsinki), Niklas Wahlberg (University of Turku and Lund University)

The phylogenetic relationships of tiger moths and woolly bears (Lepidoptera: Noctuoidea: Erebiidae: Arctiinae) are surprisingly poorly resolved, despite being subjected to ample ecological and evolutionary research and popularity among amateur and professional lepidopterologists. We present a species level phylogeny for the subtribe Arctiina with the aim to infer the phylogenetic placement of the monotypic wood tiger moth *Parasemia plantaginis*. To this end we sampled 89 species in 52 genera considered to be closely related to *Parasemia*, 11 species of Callimorphina and two outgroups. From these we sequenced up to eight gene regions including one mitochondrial (COI barcode region) and seven nuclear protein-coding gene fragments (CAD, GAPDH, IDH, MDH, Ef1 α , RpS5 & Wingless), totaling 5915 base pairs. We analyzed the DNA sequence data using both maximum likelihood (ML) and Bayesian inference (BI). Based on our results, we present a new classification, where we consider *Arctia*, *Micrarctia*, *Apantesis*, *Chelis* and *Diacrisia* as valid genera within Arctiina s.s. and sink 33 genera as synonyms of one or other of these. The wood tiger moth *Arctia plantaginis* comb.n. is placed as sister to hebe tiger moth *Arctia festiva* comb.n..

62. American mink impacts on European adder and common grass snake in the Baltic archipelago

Pälvi Salo (University of Turku)

Invasive alien vertebrate predators may have severe detrimental impacts on native fauna, sometimes even leading to species extinctions. While numerous population declines are rather well documented in mammals and birds, there is a shortage of data on the impact of alien predators on terrestrial ectothermic vertebrates like snakes. In Europe one of the most widespread non-native predators is the American mink (*Mustela/Neovison vison*), a semi-aquatic mustelid with a generalist diet. Throughout its introduced range the mink has been accused of the decline of many native species. One of the best-studied ecosystems affected by mink is the outer Archipelago Sea, SW Finland, where mink is the only common terrestrial mammalian carnivore. Mink predation has been shown to reduce densities of all prey groups studied so far, including voles, amphibians and several species of birds. However, the effect of mink on the two native predator species in the archipelago, European adder (*Vipera berus*) and common grass snake (*Natrix natrix*), is still unknown. Mink are known to occasionally prey on snakes; in addition, as snakes and mink share common prey species, snakes may suffer from resource competition in the presence of mink. Snake abundances were monitored using visual area searches and capture-mark-recapture techniques on 10 mink removal and 10 control islands in the Archipelago National Park in 2011-2013. The abundance of vole and amphibian prey on the islands was also estimated. Adder and grass snake abundances are expected to be lower on the control islands because of the combined costs of predation by and resource competition with American mink. In addition, the two snake species may be affected differently, for example with nonvenomous grass snakes suffering more from mink predation.

63. Injection of thyroid hormones improves hatching in a domesticated bird species (the Japanese quail, *Coturnix japonica*)

Tom Sarraude (University of Turku), Suvi Ruuskanen (University of Turku), Bin-Yan Hsu (University of Turku)

Thyroid hormones are crucial for both avian development and reproduction. Transferred from the mother, they increase growth, but deviations from critical range have the opposite effect. They are also needed for differentiation/maturation several tissues (e.g. central nervous system, muscles, skeletal system) and important in successful hatching. For example, inhibition of thyroid function in chicken hens resulted in impaired hatchability of their eggs. Concerning developmental effects, both hypo- and hyperthyroidism result in reduced growth, i.e. increase in body mass. However, there is a lack of experiments and data on variation within the physiological range. Japanese quail eggs were collected from breeding pairs in our facilities at the University of Turku and assigned to one of the following treatments (N=40/treatment): i) T3; ii) T4; iii) T3 + T4; or iv) Control (saline solution). The thyroid injections correspond to an increase of two standard deviations (i.e. within natural range). Eggs were subsequently incubated in an artificial incubator. Eggs treated with thyroid hormones had a higher hatching success than control eggs. This result is consistent with previous studies on Rock pigeon, but in contrast with results found on Great tits. The growth data of the chicks still need to be analysed.

64. AlloCarb: Investigating terrestrial support of aquatic food webs

Jos Schilder (Aquatic Sciences, University of Jyväskylä), Mikko Kiljunen (Aquatic Sciences, University of Jyväskylä), Heikki Hämäläinen (Aquatic Sciences, University of Jyväskylä), Roger Jones (Aquatic Sciences, University of Jyväskylä)

An important recent conceptual development in limnology argues that allochthonous (terrestrial) organic matter can represent a potentially significant carbon and energy subsidy for lake food webs (consumer allochthony). However, strongly voiced counter-arguments are that allochthonous organic matter is a low quality resource, and that consequently allochthony cannot be of significance to consumers. This remains one of the most

controversial current issues in freshwater ecology which will only be resolved when more comprehensive data become available. Evidence for an important contribution of consumer allochthony derives mostly from stable isotope analysis (SIA) of carbon ($\delta^{13}\text{C}$) as a tracer of organic matter of different origins based on differences in $\delta^{13}\text{C}$ values between different sources of organic matter. However, the small difference in $\delta^{13}\text{C}$ values between terrestrial organic carbon from northern lake catchments and $\delta^{13}\text{C}$ values of organic matter produced within lakes has seriously constrained the utility of this approach. Moreover, much of the research (e.g. ^{13}C -additions to the in-lake DIC pool) has been restricted to small lakes, and therefore available information about consumer allochthony in lakes is biased towards small lakes. New evidence has shown hydrogen stable isotope ratios ($\delta^2\text{H}$) to differ markedly between terrestrial and aquatic sources of organic matter, and hence to offer much greater potential to trace the contribution of terrestrial organic matter to lake consumers. With our poster we present the four year project AlloCarb in which we will use a multi-isotope ($\delta^2\text{H}$, $\delta^{13}\text{C}$, $\delta^{15}\text{N}$) approach to investigate many components of the food web of a large number of lakes to evaluate patterns of consumer allochthony across a wide range of lakes. We aim to resolve the outstanding controversy of whether allochthonous resource support for consumers at different trophic levels is a general phenomenon or is only important in certain lake types.

65. The fractal connectivity of patch landscapes

Torsti Schulz (University of Helsinki), Elina Numminen (University of Helsinki)

The use of measures of fractal dimension in landscape ecology was vibrant especially in the 1990s. Nonetheless, few large scale empirical studies have been conducted on the topic and the interest in it has since somewhat subsided. We apply the fractal dimension of a patch landscape as a tool for landscape and metapopulation ecological analysis in the empirical context of two biologically very distinct species, the Glanville fritillary butterfly and Ribwort plantain powdery mildew, both present as metapopulation on a shared host plant patch network in the Åland Islands. We predict metapopulation size and patch occupancy as a simple function of the fractal dimension of the patch network and the fractal dimension of network occupancy. Given that these measures require relatively little knowledge of the biology of the studied species, just data on the habitat patches and occupancy status, they should be applicable even in systems in which detailed data on the study species' population dynamics and landscape composition are not easily obtainable.

66. Personality in semi-captive Asian elephants

Martin Seltmann (University of Turku), Virpi Lummaa (University of Turku), Mark Adams (University of Edinburgh), Khyne Mar (University of Sheffield), Mirkka Lahdenperä (University of Turku)

Evidence for animal personality is numerous. However, data on personality of long-lived, highly-social wild mammals with high cognitive abilities are rare or sample sizes small. We investigated the personality structure of Asian elephants (*Elephas maximus*) by utilizing a large sample of semi-captive timber elephants of Myanmar. This population is ideal for the study of personality as its demographic parameters resemble truly wild Asian elephants. Data was collected using questionnaires, for which elephant riders (mahouts) scored 30 behavioural traits on a scale of 1 to 4 (behaviour expressed very rarely to most of the time). Whenever possible, multiple questionnaires were obtained for each elephant from several raters, resulting in 496 ratings of 221 elephants. Furthermore, we studied the relationships between personality and elephant age, sex and origin (wild-caught vs captive-born). Elephants expressed five personality factors, which were Agreeableness, Seriousness, Neuroticism, Dominance and Curiosity. Females were more agreeable than males, whereas males were more curious and more dominant than females. Dominance moderately increased, while Seriousness slightly decreased with age. There was a strong trend for Neuroticism decreasing with age and no differences by elephant origin. The personality structure of Asian elephants and the related age and sex effects are similar to humans and non-human primates, which could be due to their shared high sociality, long lives and strong cognitive abilities. Our findings provide a much-needed vital data point in comparative personality research in highly

social long-lived mammals and offer the basis for more studies on the selective pressures generating and maintaining personality differences in wild animal populations.

67. Pigment colouration change in social insects as an indicator of environmental change

Oksana Skaldina, Jouni Sorvari

Global environmental change results in changed abiotic and biotic conditions for the living organisms, frequently leading to stress and requiring rapid adaptations. These adaptations may evolve on different levels of biological organization, and be noticeable at the cellular, tissular and organ levels at first. Therefore, various pigment colouration traits in different organisms such as corals, fishes, reptiles, amphibians and birds have been shown to be effective and non-invasive early indicators of adverse anthropogenic effects. However, this remains practically unstudied in eusocial insects. Social insects from the order Hymenoptera (ants, bees, wasps and bumblebees) are important predators, pollinators, scavengers and ecosystem engineers globally. By using combined methods including digital photo analyses, morphometrics and genetics we studied several pigment colouration traits (mainly melanin based) in red wood ants *Formica rufa*, *F. aquilonia* and common wasps *Vespula vulgaris* from Finnish populations. First, the results revealed, that polymorphic colour traits of red wood ants are independent from the paternal effect, which increases genetic diversity, and therefore they are more likely the result of the particular environmental than genetic factors. Second, cuticular melanisation of *F. aquilonia* gynes is sensitive to forest disturbance, as in clear-cuts and forest edges there is an increased rate of highly melanised individuals. Finally, cuticular darkness of *V. vulgaris* is sensitive to abiotic conditions and environmental stress. Therefore, pigment colouration traits of social insects can be promising indicators of environmental change.

68. Diversity and ecology of lichen-associated fungi in East Africa a novel lichenicolous fungus from an epiphytic tripartite cyanolichen

Ave Suija (University of Tartu), Ulla Kaasalainen (University of Helsinki / National Museums of Kenya), Paul Kirika (National Museums of Kenya), Jouko Rikkinen (University of Helsinki)

Lichens are defined as ecologically obligate symbioses between fungi and green algae and/or cyanobacteria. Nearly one-fifth of all currently known fungi are lichen-symbiotic. Within the lichen thallus the photobionts provide sugar and/or fixed atmospheric dinitrogen to the mycobiont. The fungus, in turn, provides the photobionts water, carbon dioxide, and an environment relatively well buffered from environmental extremes. While lichens have traditionally been mainly perceived as pair wise interactions between one fungus and one or two photobionts, they may actually incorporate a plethora of associated microorganisms. Recent studies have shown that lichen thalli commonly host diverse communities of non-phototrophic bacteria. Also the diversity lichen-associated fungi is remarkable, both on the outer surfaces and within photobiont layers of lichen thalli. Nearly 2 000 species of lichenicolous fungi have so far been described throughout the Ascomycota and Basidiomycota, and thousands of additional species are believed to still await description. In the framework of lichenological exploration of tropical mountains forests in Kenya, a remarkable undescribed lichenicolous fungus was repeatedly found growing on thalli of the tripartite cyanolichen *Pseudocyphellaria* cf. *clathrata*. Molecular phylogenetic analyses place the new genus into Gomphillaceae (Ostropales), a family mainly of lichen-symbiotic species in the tropics. While the morphology and development type of ascomata confirm its taxonomic affinity, the precise ecology of the new fungus remains poorly understood.

69. Does the predation risk shape the foraging behaviour of beavers?

Janne Sundell (University of Helsinki, Lammi Biological Station), Julien Salandre (Jean Monnet University & Lammi Biological Station), Rahel Beil (University of Applied Sciences Weihenstephan-Tries), John Loehr (University of Helsinki, Lammi Biological Station)

Foraging herbivores have to trade-off between energy requirements and predator avoidance. We aimed to study the relative roles of these factors in beavers (*Castor canadensis*) when foraging on land. We hypothesized that beavers were able to assess the risk of predation by using two main cues: the distance from water, and the

presence or absence of predator odors. First, we studied the food selection of beavers in relation to distance from the water in natural settings. Transects were made at beaver ponds and the diameter, species, and distance from the shore of intact and beaver cut trees were recorded. Secondly, we placed rows of aspen sticks (*Populus tremula*) perpendicular to the shore around beaver ponds, and treated each row with a neutral, alien, or wolf odor. We found that aspen, downy birch (*Betula pubescens*) and speckled alder (*Alnus incana*) were preferred tree species. More of these species were cut close to the shore and cut trees were smaller further away from the shore, except in the case of aspen. In the experiment, most of the aspen sticks were taken close to the shore. As predicted, beavers took less aspen sticks in rows treated with wolf odor than water. As the predator odor did not affect the foraging distance from the shore, it is likely that our observation that foraging was the most intense close to shore, is due to energetic constraints. However, predation risk probably affects the decision whether to forage on the land in the first place.

70. Linking long-term genetic, demographic and epidemiological dynamics in the *Linum marginale* *Melampsora lini* system

Hanna Susi (CSIRO, Australia), Peter H Thrall (CSIRO, Australia), Luke G Barrett (CSIRO, Australia), Jeremy J Burdon (CSIRO, Australia)

At the coevolution of host and pathogen both organisms are exposed to selection by the other. However there is a lack of long-term data exploring the phenotypic, genetic and demographic consequences of pathogen epidemics on the host and the selection by host on the pathogen population. *Melampsora lini* is a rust fungus infecting native flax, *Linum marginale*, in South East Australia where its epidemiology and evolution has been intensively studied since 1986. Here we report long-term demographic, genetic and epidemiological patterns in this wild plant pathogen system. To investigate patterns of disease prevalence and severity and track effects on host fecundity and demography censuses were conducted on an annual basis at a single site. We found that during the 12-year study period severe epidemics oscillated in 3-4 year cycles leading to population decrease. The disease prevalence ranged 0% to 99% hosts infected. At the individual host level we were able to compare the lifetime fecundity of the hosts across several epidemics of varying intensity. The results showed that the pathogen has significant impact on the host fecundity and overwinter mortality. To examine pathogen's long-term genetic dynamics we combined datasets of its phenotypes, infectivity gene variation and whole genome variation spanning 25 years and three populations with varying ecological conditions (two host ecotypes: bog and hill). The results indicated that adaptation to local conditions shaped the pathogen populations rather than directional evolution. Furthermore, when we compared the genetic structures of populations we found that host ecotype was the selecting force rather than isolation by distance. The two bog populations showed similar pattern in their phenotypic, infectivity gene and genetic cluster composition despite the geographic distance. These findings increase our understanding on the evolution and epidemiology of the host-pathogen associations in wild.

71. Adjustment of host manipulation efforts by a fish eye fluke parasite

Jouni Taskinen (University of Jyväskylä), Victor Mikheev (Russian Academy of Sciences, Moscow), Mikhail Gopko (Russian Academy of Sciences, Moscow)

Parasites manipulate their hosts phenotype to increase their own fitness. Like any evolutionary adaptations, parasitic manipulations should be costly. In theory, (1) as the parasite infrapopulation size (parasite population within a single host individual) grows the investment of individual parasite in host manipulation should decrease because of cost sharing among the parasite individuals. In addition, (2) in environments, where probability of predation by a suitable host is low, the parasite should decrease its investment in the manipulation. We experimentally infected two fish species, the rainbow trout *Oncorhynchus mykiss* and sunbleak *Leucaspis delineaatus*, with immature larvae of the trematode *Diplostomum pseudospathaceum* to test these hypotheses. Immature *D. pseudospathaceum* metacercariae, common parasites of fish eye lens, are known for their ability to manipulate host behaviour to reduce predation risk (i.e., make their host less vulnerable to the predation) until

parasites reach infectivity. We studied how growth rate of *D. pseudospathaceum* metacercariae was affected by the infrapopulation size and presence of the predation threat in the environment. In both host species we found that the size of parasite individuals increased with the infrapopulation size suggesting cost sharing. In addition, parasites adjusted their investment in growth not only to the infrapopulation size, but to the numbers of conspecifics in the local aggregation (individual eye lens) within the host. Furthermore, in environment without suitable predator, when there is no need to manipulate the host, immature *D. pseudospathaceum* metacercariae grew faster in sunbleak when compared to environment with the scent of predator, indicating a lower investment to manipulation of host. Thus, our results support the hypothesis that parasites can adjust their manipulation effort according to the costs and benefits of manipulation such as cost sharing or predation (transmission) possibilities.

72. Mycorrhizal fungi in wood-pastures

Kaisa Tervonen (University of Jyväskylä), Anna Oldén (University of Jyväskylä), Panu Halme (University of Jyväskylä)

Traditional rural biotopes such as wood-pastures are species-rich environments that have been created by low-intensity agriculture. Their amount has decreased dramatically during the 20th century in whole Europe due to the intensification of agriculture. Wood-pastures host some fungal species that prefer warm areas and are adapted to semi-open conditions, but still very little is known about fungi in these habitats. We studied how management, historical land-use intensity, present grazing intensity, time since abandonment, and stand conditions affect community composition of mycorrhizal fungi. We found that the proportion of broadleaved trees, soil pH, and soil moisture are the major drivers of the mycorrhizal fungal communities in boreal wood-pastures. Management, grazing intensity or historical land-use intensity did not have any effect. To conclude, present stand conditions are the most important factors to evaluate when planning the conservation of mycorrhizal fungi dependent on semi-open forest habitats.

73. Assessing the dependency of species-to-species associations on the environmental context with joint species distribution models

Gleb Tikhonov (University of Helsinki), Otso Ovaskainen (University of Helsinki), Nerea Abrego (Norwegian University of Science and Technology), David Dunson (Duke University)

During the last decade the field of statistical ecology has been dramatically evolving. One of key breakthroughs was the emergence of joint species distribution models (JSDM), which have already become the standard analysis tool for community ecology data. Modern JSDMs enable researchers to estimate species associations (residual co-occurrence patterns after accounting for environmental niches) from large datasets, as well as to obtain more accurate predictions by accounting for such associations. However, the JSDMs developed thus far were critically limited to assume constant species associations, whereas in real ecological communities, the direction and strength of interspecific interactions are likely to vary depending on environmental conditions. Here we build on the existing JSDMs that utilize a latent factor structure, and propose an extension, where the factor loadings are modelled as a linear regression to environmental covariates, which enables species-to-species associations to be dependent on measured environmental context. We demonstrate the performance of the proposed statistical framework using both simulated and real data. Our results show that JSDMs perform consistently better in inferring environmental-dependent species associations than single species distribution models, especially with sparse data. Furthermore, we illustrate that our model can capture even nonlinear dependencies in species-to-species associations. The proposed statistical method provides robust and convenient means for ecologists who attempts to study the dependency of interspecific interactions on environment using non-manipulative observational community data.

74. Environmental drivers of vascular and non-vascular epiphyte abundance in tropical premontane cloud forests in Northern Peru

Johanna Toivonen (Department of Biology, University of Turku), Lassi Suominen (Department of Biology, University of Turku), Carlos A. Gonzales-Inca (Dep. of Geography and Geology, University of Turku), Gabriel Trujillo Paucar (División de Limnología, CORBIDI, Lima, Peru), Mirkka M. Jones (Department of Biology, University of Turku)

Epiphytes form an important part of above-ground non-woody biomass and forest ecohydrological functioning in tropical montane cloud forests. Understanding the role of environmental drivers for different epiphyte plant groups is relevant helping to estimate their sensitivity to ongoing and future climate and land use changes. In this research, we aimed to find out, which forest structural features are the best predictors of epiphyte abundance, and what is the role of microclimate in comparison to forest structural features in explaining the abundance of each studied epiphytic plant group (bryophytes, bromeliads, aroids, ferns). The study was carried out in lower montane cloud forests in the tropical Andes of Northern Peru. We recorded vascular epiphytic abundance, epiphytic bryophyte cover and forest structural features in 35 plots (20 m x 20 m), and measured air temperature and humidity in a subset of 17 plots. We modelled epiphyte abundance as a function of forest structure and microclimate in SARerr regression models. Three forest structural variables (basal area, tree height and canopy openness) and two microclimatic variables (minimum humidity and maximum temperature) were considered. We reduced the candidate variables into two PCA components to avoid over-fitting. We used model averaging based on AICc weights to select the best overall models. Canopy openness was the most important forest structural feature explaining epiphyte abundance. Bryophyte cover was estimated reasonably well with forest structural variables alone, whereas the model of total vascular epiphytic abundance improved significantly with the inclusion of microclimatic data. However, there was considerable variation among the main vascular epiphytic groups, with ferns responding most strongly to microclimate. This implies that these taxa will also differ in their sensitivity to predicted future changes in temperature and rainfall.

75. Enhancing farmland biodiversity through environmental fallows

Marjaana Toivonen (University of Helsinki), Irina Herzon (University of Helsinki), Mikko Kuussaari (Finnish Environment Institute)

Environmental fallows are fields temporarily taken out of production in order to produce environmental benefits instead of agricultural products. In many European countries, the establishment and management of environmental fallows is promoted through agri-environment schemes. The factors affecting biodiversity values of environmental fallows in boreal farmland were examined in two field studies, in which the species diversity and community composition of plants, bumblebees, butterflies and birds were studied in different fallow types and landscape contexts. The species richness and composition of the studied taxa differed substantially between fallow types, and landscape structure further modified the value of fallows. Perennial fallows established with meadow seed mixtures supported high plant species richness and bumblebee abundance. Old grassland fallows benefitted butterflies in general, and bumblebees and butterflies with narrow niches and low dispersal capacities. The positive effects were emphasized when long-term fallows were located in complex landscapes with high cover of forest and perennial grasslands. The breeding density of open farmland birds was highest in meadow fallows in landscapes rich in perennial grasslands. Foraging edge birds preferred meadow fallows in open landscapes and old grassland fallows in forested landscapes. Vegetation of annual fallow types differed considerably from perennial fallows and other non-crop biotopes. The results suggest that the biodiversity benefits of environmental fallows could be enhanced by adapting fallows to the landscape context and specific conservation objectives. Managing long-term fallows in complex landscapes is the best strategy to support species of conservation concern. Overall biodiversity can be enhanced also in short-term fallows that are sown with diverse seed mixtures. Depending on sown species, short-term fallows can enhance landscape heterogeneity and promote ecosystem services.

76. Ecological uniqueness of stream macroinvertebrate communities at high latitudes: insights from taxonomic and trait data

Katri Tolonen (Finnish Environment Institute), Kirsti Leinonen (Finnish Environment Institute), Jaakko Erkinaro (Natural Resources Institute Finland), Jani Heino (Finnish Environment Institute)

Ecological uniqueness of a site describes the contributions of individual communities to the overall beta diversity of a region. Understanding the environmental drivers behind the variation in this ecological uniqueness would enhance greatly our understanding of the mechanisms structuring the whole biodiversity in the region. This question is especially important for stream communities. Streams are among the most threatened ecosystems, and to be able to protect their biodiversity in the changing world, it would be crucial to understand the mechanisms determining the variation in their ecological uniqueness. The aim of this study was to discover the potential causes and environmental factors driving the ecological uniqueness of macroinvertebrate communities in streams in a high-latitude catchment in two seasons. By calculating the degree of uniqueness of the streams in terms of their taxonomic and functional community composition and by modelling the resulting index values using spatial and environmental variables, we showed that the ecological uniqueness of the northern streams depends mainly on environmental filtering, although some indication of the effect of spatial-processes structuring the communities was present especially in the autumn. High-latitude stream communities also appear to be sensitive to small environmental changes. Overall, to maintain diversity in high-latitude streams, it would be important to protect varying habitat conditions, the main force causing variation in the ecological uniqueness of the streams.

77. Comparative analysis of the codon usage in Zika virus

Phuoc Truong (Department of Biology, University of Turku), Pere Puigbo (Department of Biology, University of Turku)

Zika virus is a mosquito-borne Flavivirus that was first discovered in Uganda in 1947, from where spreaded along the Equator through Asia. The first report of the virus in South America was in Easter Island (Chile) in 2014. Zika virus has been a major widespread pathogen in South America since early 2015. Currently, Zika viruses can be divided into three different genotypes: East-African, West-African and Asian (which also includes viruses circulating in North and South America). In this study we compare the synonymous codon usage among all three genotypes and within the Asian type. Full genome sequences, obtained from the NCBI s virus variation database and the Virus Pathogen Resource (ViPR), are analyzed with the web-servers CAIcal and DendroUPGMA. The relative synonymous codon usage (RSCU) values are used to build a UPGMA dendrogram based on Pearson correlations. The resultant tree is free of any genetic recombination effect and clusters together those genomes with similar use of synonymous codons. The three major Zika genotypes can be easily identified from the tree, but there are only minor differences between sequences from Asia, Oceania and the Americas.

78. Mapping Amazonian biodiversity and geology using basin-wide fern species inventories and Landsat imagery

Jasper Van doninck (University of Turku), Gabriela Zuquim (University of Turku), Gabriel Moulatlet (University of Turku), Glenda Cárdenas (University of Turku), Hanna Tuomisto University of Turku)

Fern species composition has proved to be a good predictor of species composition and turnover of other plant groups, as well as of soil properties in Amazonian rain forests. We have gradually accumulated a dataset of more than 1000 line transects across Amazonia that provide information on fern species composition and soil properties. These field inventories have allowed us to document high local-scale floristic heterogeneity, and to relate it to geological formations. However, field inventories can only cover small parts of the Amazon basin, so satellite remote sensing is an indispensable tool when the aim is comprehensive mapping of Amazonian biodiversity and geology. Our earlier research has shown that spectral patterns in individual Landsat scenes

reflect patterns in fern species composition and geology very well. However, radiometric artefacts in Landsat imagery have hampered their use over larger areas. Now we have succeeded in creating a workflow that takes advantage of both recent advances in image preprocessing (atmospheric correction, directional normalization and image compositing) and of the computing capabilities of the CSC - IT Center for Science. We are now generating a radiometrically consistent, cloud-free Landsat TM/ETM+ image composite that covers the entire Amazon basin. Here we present preliminary results from combining this Landsat mosaic with fern data. This illustrates the potential of the approach for mapping plant biodiversity and geology at a semi-continental scale but with fine spatial resolution.

79. Effects of predation and habitat on nest-site occupancy of two arboreal squirrels

Tytti Turkia (University of Turku), Erkki Korpimäki (University of Turku), Alexandre Villers, Vesa Selonen (University of Turku)

When choosing a habitat, animals face trade-offs between food availability, predation risk, and other specific habitat characteristics. Natural selection favors optimization of the effects on fitness in different habitats. Predators affect prey directly by inducing mortality, but also indirectly through creating what is called a predation risk landscape, affecting the movement and habitat use of prey individuals, and ultimately, the whole population. Together, habitat fragmentation and predation pressure may modify population densities more or in a different manner than either factor alone. This makes it important to consider both factors when aiming to understand the distribution of animals in space. Arboreal squirrels are dependent on forests habitat, which often is under heavy human use, making these species potentially sensitive to habitat composition at the patch and landscape level. For example, the Siberian flying squirrel (*Pteromys volans*) and the Eurasian red squirrel (*Sciurus vulgaris*) are declining species both potentially suffering from habitat loss in managed forest landscape. Here, we analyse the effects of predation pressure and habitat composition and their interaction on two different scales on occupancy of nest-boxes by nationally threatened flying squirrel and more common, but also declining red squirrel in central Finland. We predict that (i) predator presence has a negative and increasing area of preferred habitat a positive effect on squirrel nest-box occupancy. We also anticipate the strength of these effects to reflect the relative roles of predators and habitat on site occupancy. In addition we (ii) predict interactive effects between amount of a preferred or non-preferred habitat and predation risk on nest-box occupancy, and, for red squirrels, also between habitats and amount of food. For red squirrels, we presume (iii) habitat use to also depend on food abundance.

80. Maternal environment induces adaptive pheno- and epigenotypes in bank voles

Joannes van Cann (University of Jyväskylä), Esa Koskela (University of Jyväskylä), Tapio Mappes (University of Jyväskylä), Phill Watts (University of Oulu)

Rapid responses to environmental change that are longer-term than individual plasticity yet shorter than evolutionary change would be beneficial to individuals. However, the relationship between environment, epigenetics and phenotypic traits is still uncertain. Bank voles (*Myodes glareolus*) experience population cyclicity which induces environmental stressors, such as increased population density and/or reduced food availability. By exposing females ecologically-relevant stressors it is possible to reveal the effects of early life stress upon fitness as well as underlying epigenetic mechanisms. Wild gravid females were given social and/or dietary stress (2x2 factorial design). Reproductive success, growth and survival of their F1/F2 offspring was monitored in high/low population densities in large outdoor enclosures. Mothers responded to stress by altering sex ratio and size of F1 offspring, and these effects persisted to the morphology and litter size in the subsequent generation. F2 offspring from prenatally stressed individuals did not suffer the costs of a high density environment, such as reduced growth ratios, indicating that they have been primed to their future environment. In F1, methylation patterns of oxytocin and oxytocin receptor showed clear relations to the native environment. This patterns persisted to some degree in F2, indicating that epigenetic pathways may be important in adapting to changing environments

81. Nutrient enrichment modifies biodiversity-temperature relationships

Jianjun Wang (Department of Geosciences and Geography, University of Helsinki), Feiyan Pan (Jiangsu Key Laboratory for Molecular and Medical Biotechnology, Nanjing Normal University), Janne Soininen (Department of Geosciences and Geography, University of Helsinki), Jani Heino (Finnish Environment Institute, Natural Environment Centre, Biodiversity, Oulu), Ji Shen (State Key Laboratory of Lake Science and Environment, Nanjing Institute of Geography and Limnology, Chinese Academic of Sciences, Nanjing)

Climate effects and human impacts, such as nutrient enrichment, simultaneously drive spatial patterns in global biodiversity. However, there is little consensus about their independent effects due to the covariance of climate and local environments. Here, we conducted large-scale field experiments manipulating nutrient enrichment in aquatic sterilized microcosms colonized by airborne microbes along temperature gradients in subarctic and subtropical regions. Temperature and nutrient enrichment directly affected bacterial species richness and community composition and also indirectly influenced biodiversity through primary productivity. Temperature had the greatest effect on species richness at extreme nutrient levels, and nutrients had the greatest effect at intermediate temperatures. Our experiments provide important insights into how nutrient enrichment may alter biodiversity under future climate scenarios.

82. Integrated research on parasitic disease in wild salmonid fish: linking genomes, physiology and ecology

Anti Vasemägi (University of Turku), Paul Debes (University of Turku), Freed Ahmad (University of Turku), Bruneaux, Matthieu; University of Jyväskylä), Lilian Pukk (Estonian University of Life Sciences), Riho Gross (Estonian University of Life Sciences), Petteri Ilmonen (University of Turku), Janina Stauffer (University of Turku), Veljo Kisand (University of Tartu), Ilkka Nousiainen (University of Turku), Mikhail Ozerov (University of Turku), Siim Kahar (University of Turku), Marko Visse (University of Tartu)

Proliferative kidney disease (PKD) is an emerging temperature-driven parasitic disease in farmed and wild salmonids in northern hemisphere caused by myxozoan *Tetracapsuloides bryosalmonae*. We present the results of an integrated research program to shed light on genomic, physiological and ecological aspects on this host-parasite system. In particular, we i) apply quantitative genetic approaches in wild pedigrees to understand the genetic architecture of the disease; ii) use genome wide associations for detection of genomic regions linked to resistance and disease severity; iii) estimate the physiological consequences of the disease by measuring host oxygen consumption rates, thermal tolerance, oxidative stress and telomere attrition; iv) characterize the transcriptome of the parasite using dual RNAseq; v) test the effect of disease on host gut-microbiome; vi) apply longitudinal analysis to quantify the parasite effect on survival and growth; vii) aim to develop novel monitoring approaches of the parasite from water samples (environmental DNA).

83. Contrasting pathogen life-history strategies to persist across space and time in natural metapopulation

Elise Vaumourin (University of Helsinki), Elina Numminen (University of Helsinki), Lucie Poulin (University of Helsinki), Steve Parratt (University of Helsinki), Anna-Liisa Laine (University of Helsinki)

Understanding the mechanisms by which diversity is maintained in pathogen populations is critical for predicting where pathogens will occur and how risk of infection evolves. Life-history trade-offs have been proposed as a hypothesis for explaining long-term maintenance of variation in pathogen populations, yet the empirical evidence supporting trade-offs has remained mixed. This is in part due to the challenges of documenting successive pathogen life-history stages in many pathosystems. Moreover, remarkably little is understood of how life-history trade-offs impact on pathogen dynamics during natural epidemic. Here, we focus on the fungal pathogen *Podosphaera plantaginis* infecting host plant *Plantago lanceolata* to study life-history traits and possible trade-offs in seven pathogen strains throughout their full life-cycle and in relation with their

wild prevalences in Åland Island metapopulation. We examine key traits in the pathogen's asexual and sexual stages, as well as its resistance to a hyperparasite. We find significant variation among the seven strains in the life-history traits that constitute the infection cycle. We find also positive correlations among the life-history traits – initially fast strains tend to be fast also in the subsequent life-history stages, while no direct evidence for trade-offs was found. Using information on the frequency of the strains in their natural environment we show – for the first time – strains that represent the most common multi-locus genotypes in the natural pathogen metapopulation exhibit contrasting life-history strategies, suggesting that there are different, but equally successful ways to persist across space and time. Such differences in life-history strategies are likely to promote the maintenance of variation in wild pathogen populations that are subject to spatial and temporal variation in their environments.

84. Disintegration process of Proto-Uralic language revised with phylogenetic methods

Outi Vesakoski (University of Turku), Sanni Översti (University of Helsinki), Aripekka Junno (University of Groningen), Kaj Syrjänen (University of Tampere), Terhi Honkola (University of Turku), Päivi Onkamo (University of Helsinki)

Our work presented here adds to the attested phylogenetic methods applied to data of historical linguistics. Finnish, Hungary, Saami languages and multiple minor languages in Russia are part of the 30-40 languages belonging to Uralic language family. The age of the family, its disintegration patterns and the relationships of its clades are still under debate. We used basic word list of 313 meaning (313 loci) with cognate coding (allelic homoplasy) to 1) conduct partition analyses (Tiger) to answer the concerns related to variation in speed of change within the data potentially affecting the evolutionary models behind the tree building algorithms, 2) apply latest improvements in timing analyses (BEAST) to create a chronological tree of the Uralic family with the partitioned data and 3) to study the unresolved question of divergence pattern of Proto-Uralic language stage (Phycas analyses). With partitioned data and careful model selection we ended up to disintegration of Proto-Uralic (PU) about 5000 years ago. This supports the most recent hypotheses preferring 4000 years instead of earlier suggestions of 6000 or even 7000 years since the first divergence. Contradicting the latest assumptions in historical linguistics, Phycas-analyses strongly suggested binary divergence of PU into Samoydic and Finno-Ugric (FU) languages. The dispersion of FU instead seems more polytomous suggesting rapid expansion of languages. We will also discuss the advantage of the statistical approach in transforming the basic research of historical linguistics into applied historical linguistics, with data and outcomes comparable to other fields of studies in human (pre)history.

85. Diversity of fungus-growing termites (*Macrotermes*) and their fungal symbionts (*Termitomyces*) in the semiarid Tsavo Ecosystem, Kenya

Risto Vesala (University of Helsinki), Tuula Niskanen (Royal Botanic Gardens, Kew), Kare Liimatainen (University of Helsinki), Hamadi Boga (Taita-Taveta University), Petri Pellikka (University of Helsinki), Jouko Rikkinen (University of Helsinki)

Fungus-growing termites of the subfamily Macrotermitinae together with their highly specialized fungal symbionts (*Termitomyces*) are primary decomposers of dead plant matter in many African savanna ecosystems. Foraging termites feed on dry grass, dead trees, fallen leaves and other plant derived material and deposit it into specialized sponge-like structures, fungus combs, inside their nests where e.g. cellulose and lignin are effectively degraded by the *Termitomyces* mycelium. Termites provide crucial ecosystem services also by modifying soil properties, translocating nutrients, and acting as important drivers of plant succession. Despite their obvious ecological importance many basic features in the biology of fungus-growing termites and especially their fungal symbionts remain poorly known. For example no studies have so far focused on possible habitat level differences in symbiont diversity across heterogeneous landscapes. We studied the species identities of *Macrotermes* termites and their *Termitomyces* symbionts by excavating 143 termite mounds at

eight study sites in the semiarid Tsavo Ecosystem of southern Kenya. Reference specimens were identified by sequencing the COI region from termites and the ITS region from symbiotic fungi. Our results demonstrate that the regional *Macrotermes* community in Tsavo includes two sympatric species (*M. subhyalinus* and *M. michaelseni*) which cultivate and largely share three species of *Termitomyces* symbionts. A single species of fungus is always found in each termite mound, but even closely adjacent colonies of the same termite species often house evolutionarily divergent fungi. The species diversities of both partners vary markedly between sites, suggesting hitherto unknown differences in their ecological requirements. It seems apparent that both habitat heterogeneity and disturbance history can influence the local diversity and distribution patterns of both partners in symbiosis.

86. Occurrence, species and alkaloid assemblage of *Claviceps purpurea* sensu lato in Finnish wild and agricultural grasses

Pauliina Wäli (University of Oulu), Saravesi Karita (University of Oulu), Mervi Rokka (Finnish Food Safety Authority), Marika Jestoi (Finnish Food Safety Authority), Kari Saikkonen (Natural Resources Institute Finland), Piippa Wäli (University of Oulu)

Ergot, *Claviceps purpurea* sensu lato, is a common and toxic fungal seed pathogen that infects grasses and cereals. In this study, we explored the occurrence, diversity and alkaloid profiles of the strains/proposed species of the newly delimited *C. purpurea* sensu lato in Finnish grass populations. Pooled population samples of ergot sclerotia from wild and meadow grasses and cereals were used for next-generation sequencing (Ion Torrent) of rDNA ITS1-region. Whole ITS-region (by Sanger method) of representative ergot samples was used as a reference for the NGS data. Part of the pooled sample sets were used also for qualitative and quantitative analyses of ergot alkaloids (liquid chromatography/mass spectrometry (LC-MS/MS)). Based on our data, *C. humidiphila* is the predominant ergot species in Finnish wild grasses, and there is only little variation in the ITS1-region. *C. purpurea* sensu stricto is present on cereals and some wild grass species, sometimes together with *C. humidiphila*. There is more variation within the ITS1-region of samples falling into *C. purpurea* sensu stricto, and the sequences can be grouped into two genetic groups or races. Based on alkaloid analyses, alkaloid contents vary greatly within Finnish ergot samples, regardless of the species.

87. Impact of moth outbreaks on *Empetrum nigrum* ssp. *hermaphroditum* and its fungal pathogens in mountain birch forest treeline

Piippa R. Wäli (Dept of Ecology and Genetics, Uni Oulu), Anna Liisa Ruotsalainen (Dept of Ecology and Genetics, Uni Oulu), Lars Ericson (Dept of Ecology and Environmental Sci., Uni Umeå), Annamari Markkola (Dept of Ecology and Genetics, Uni Oulu)

Some moth species have outbreaks in Fennoscandian mountain birch forests and may cause birch deaths in large areas. Also cover of *Empetrum nigrum* ssp. *hermaphroditum*, the dominant species in understorey declines severely during moth outbreaks even though *Empetrum* is not actual food for moths. We followed the changes in the *Empetrum* cover during four adjacent summers after moth outbreak in Kaldoaivi wilderness area, in the northernmost Finland. In addition, we established a controlled field experiments with 1) manipulative moth outbreaks with either a) variable duration of moth outbreak or b) different moth species and different larval densities and 2) artificial defoliation and fertilization treatments. Purpose of this research was to shed light on the mechanisms causing dramatic decline in *Empetrum* with special attention to fungal pathogens of *Empetrum* during and after the moth treatments. Experimental moth outbreaks caused similar browning in *Empetrum* seen in defoliated mountain birch forests. Neither fertilization nor defoliation alone caused the severe browning of *Empetrum* detected in moth treatments. According to field experiments autumnal moth is capable of harming the *Empetrum* at lower larval densities than winter moth. Incidences of some pathogens increased in moth treatments indicating that fungal pathogens participate the browning of *Empetrum* during the moth outbreaks.

On the other hand, the prevalence of a hemibiotrophic pathogen was higher in control plots than in moth plots indicating that moth damage may result in resource depletion for this type of pathogens.

88. Biological diversity and importance of the most southern intact forest landscape of Archangelsk region (Barents region)

Asiia Zagidullina (Saint Petersburg Forest Research Institute), Natalia Glushkovskaya (Saint-Petersburg State University), Vera Kotkova (Institute of Botany of Russian Academy of Science), Denis Mirin (Saint-Petersburg State University), Elena Kushnevskaya (Saint-Petersburg State University), Viktor Mamontov (Vodlozerskiy National Park)

The landscape on watershed of Upper Vashka and Uftuga rivers comprises pristine forests which are important for the whole Barents region. The major part is covered by coniferous mostly spruce (*Picea abies*)-dominated forests. In contrast to similar areas in Northwestern Russia, wetlands and lakes account for a relatively small proportion of the area here. The landscape exhibits high diversity of natural ecosystems and can be viewed as a representative example of the European middle taiga with preserved gradient of different successional stages and habitat types. Besides, rare types of forest ecosystems (old-growth spruce and aspen stands with *Abies sibirica*., herb rich forests, aapa- and minerotrophic swamps etc.) are revealed in the landscapes. The high proportion of pristine fir stands is unique for plain territories of Russian North-West. The forested watershed are richly inhabited by rare and endangered plant, fungi and vertebrate species, many of which are listed in the Red lists of the Russian Federation and Arkhangelsk region. Besides, many vulnerable and specialist species could be recommended to preserve additionally. The watershed forests are home to one of the last and the most southern remaining populations of endangered wild forest reindeer (*Rangifer tarandus fennicus*). These forests are crucial to the preservation of salmon spawning streams. They play an important role for regional ecosystem services - in climate regulation, water and carbon balance. Presently, commercial harvesting constitutes the biggest threat to the existence of these unique forests. Non-governmental environmental organizations (WWF Russia) and research institutions have proposed preserving the most valuable part of the areas by assigning it a status of a regional landscape reserve.

89. Using plant-soil affinities to create meaningful layers for species distribution modeling in the tropics

Gabriela Zuquim (University of Turku, Finland), Juliana Stropp (Federal University of Alagoas, Brazil), Jasper Van doninck (University of Turku, Finland), Gabriel Moulatlet (University of Turku, Finland), Fernando Figueiredo (National Institute of Amazonian Research, Brazil), Hanna Tuomisto (University of Turku, Finland)

Amazonian soil maps do not contain reliable estimations of soil properties that are ecologically meaningful for species distribution modeling (SDM). Therefore, SDM is biased towards climatic variables. To get around this problem, we developed a map of soil nutrient content for Amazonia inferred from fern occurrence data. We first used more than 1000 fern plots associated soil information to calculate species soil-nutrient optima (the pick of a fitted normal species occurrence curve). Then we downloaded fern occurrences from Global Biodiversity Information Facility (GBIF) and assigned a soil-value for each GBIF point, according to the species nutrient optima. We then interpolated the fern-derived soil values to create a raster layer of soil nutrient content in Amazonia, expressed in cation concentration. To test the resulting map, we run SDM for three common tree species using occurrence data from GBIF. Input environmental data included the fern-derived soil map plus soil and climatic variables downloaded from SoilGrids and WorldClim, respectively. Bioclimatic variables and the fern-based soil map were significant in all the models, but the SoilGrids layer was not significant or only weakly so. Even though direct measurements of soil can provide more accurate data, biological data tends to cover broader geographical areas. A fern-based soil map is therefore a promising solution to improve the quality of soil and floristic maps that are commonly used for conservation planning.

List of Participants

Last name	First name	E-mail address	Institution
Aalto	Milla	milla.m.aalto@utu.fi	University of Turku
Abrego	Nerea	nerea.abrego@ntnu.no	Norwegian University of Science and Technology
Ahola	Milla	milla.ahola@helsinki.fi	University of Helsinki (living in Turku)
Ahonen	Saija	saija.ahonen@oulu.fi	University of Oulu
Aikio	Sami	sami.aikio@gmail.com	University of Helsinki
Aivelo	Tuomas	tuomas.aivelo@ieu.uzh.ch	University of Zürich
Akujärvi	Anu	anu.akujarvi@ymparisto.fi	Finnish Environment Institute
Alahuhta	Janne	janne.alahuhta@oulu.fi	University of Oulu
Ala-Ruona	Anniina	anniina.ala-ruona@uniarts.fi	University of the Arts Helsinki
Alioravainen	Nico	nico.alioravainen@uef.fi	University of Eastern Finland
Anttila	Jani	jani.anttila@helsinki.fi	University of Helsinki
Arponen	Anni	anni.arponen@helsinki.fi	University of Helsinki
Ashrafi	Roghaieh	roghaieh.ashrafi@jyu.fi	university of Jyväskylä
Baudry	Gautier	gautier.baudry@gmail.com	University of Oulu
Beresford	Jack	jack.beresford@helsinki.fi	The University of Helsinki
Berger	Vérane	verber@utu.fi	University of Turku
Birlinger	Johannes	johannes.birlinger@uniarts.fi	University of the Arts Helsinki
Bissett	Christiana	christiana.bissett@uniarts.fi	University of the Arts Helsinki
Björklund	Heidi	heidi.bjorklund@helsinki.fi	University of Helsinki, Finnish Museum of Natural History Luomus
Borshagovski	Anna-Maria	Anna-Maria.Borshagovski@oulu.fi	University of Oulu
Briga	Michael	michbriga@gmail.com	University of Turku
Burdfeld-Steel	Emily	emily.r.burdfeld-steel@jyu.fi	University of Jyväskylä
Cai	Yongjiu	caiyj@niglas.ac.cn	Finnish Environment Institute
Cai	Yuhua	yuhua.cai@helsinki.fi	University of Helsinki
Candolin	Ulrika	ulrika.candolin@helsinki.fi	University of Helsinki
Cárdenas Ramírez	Glenda Gabriela	glecar@utu.fi	University of Turku
Cayol	Claire	claire.c.cayol@jyu.fi	University of Jyväskylä
Chapman	Simon	snchapman93@gmail.com	Turun Yliopisto
Chrysafi	Anna	anna.chrysafi@helsinki.fi	University of Helsinki
Class	Barbara	barbara.class@utu.fi	University of Turku
Crawley	Jennifer	jahcrawley1@gmail.com	Turun Yliopisto
DiLeo	Michelle	michelle.dileo@helsinki.fi	University of Helsinki
Ding	Yiyang	yiyang.ding@helsinki.fi	Faculty of Agriculture and Forestry, University of Helsinki
Dong	Xuhui	xuhuidong@aias.au.dk	Aarhus University
Donvil	Brecht	brecht.donvil@helsinki.fi	University of Helsinki
Duplouy	Anne	anne.duplouy@helsinki.fi	Metapopulation Research Centre, University of Helsinki
Eitzinger	Bernhard	bernhard.eitzinger@helsinki.fi	University of Helsinki
Eklund	Johanna	johanna.f eklund@helsinki.fi	Metapopulation Research Centre, University of Helsinki
Erkinaro	Jaakko	jaakko.erkinaro@luke.fi	Natural Resources Institute Finland (Luke)
Eronen	Jussi	jussi.t.eronen@helsinki.fi	University of Helsinki

Etkin	Shelley	shelley.etkin@uniarts.fi	University of the Arts Helsinki
Eyvindson	Kyle	kyle.j.eyvindson@jyu.fi	University of Jyväskylä
Fagerlund	Miina	fagerlundmiina@gmail.com	Espoon kaupunki
Fan	Ruili	ruili.fan@helsinki.fi	Department of mathematics and statistics, university of Helsinki
Forbes	Kristian	kristian.forbes@helsinki.fi	University of Helsinki
Fred	Marianne	marianne.fred@novia.fi	Novia University of Applied Science
Fuchs	Siiri	siiri.fuchs@helsinki.fi	Biotieteiden laitos, Helsingin yliopisto
Gagnon	Karine	karine.gagnon@abo.fi	Åbo Akademi University
Geritz	Stefan	stefan.geritz@helsinki.fi	University of Helsinki
Gohli	Jostein	jostein.gohli@gmail.com	University of Helsinki
Gordo	Oscar	ogviloslada@gmail.com	Novia University of Applied Sciences
Gordon	Swanne	swanne.gordon@jyu.fi	University of Jyväskylä
Granroth-Wilding	Hanna	hanna@granroth-wilding.co.uk	University of Helsinki
Griffin	Robert	robgriffin247@hotmail.com	University of Turku
Grönroos	Mira	mira.gronroos@helsinki.fi	University of Helsinki
Haapakoski	Marko	marko.j.haapakoski@jyu.fi	University of Jyväskylä
Haavisto	Fiia	fisoa@utu.fi	University of Turku
Hakala	Sanja	sanja.hakala@helsinki.fi	HY
Hakkarainen	Anu	anu.hakkarainen@helsinki.fi	Helsinki university
Halme	Panu	panu.halme@jyu.fi	University of Jyväskylä
Happonen	Konsta	Konsta.happonen@gmail.com	University of Oulu
Hatanpää	Aurora	aurora.hatanpaa@uef.fi	University of Eastern Finland
Hawryluk	Iwona	iwona.hawryluk@helsinki.fi	University of Helsinki
Heino	Jani	jani.heino@ymparisto.fi	Finnish Environment Institute
Heinänen	Emma	sofiasusanna@hotmail.com	Oulun Yliopisto
Helanterä	Heikki	heikki.helantera@helsinki.fi	Univ. Helsinki, Department of Biosciences
Helle	Ilona	ilona.h.helle@jyu.fi	University of Jyväskylä
Helle	Samuli	sayrhe@utu.fi	University of Turku
Henttonen	Heikki	Heikki.Henttonen@luke.fi	Natural Resources Institute Finland
Herzon	Iryna	iryna.herzon@helsinki.fi	University of Helsinki
Hindström	Rasmus	hindstrom.rasmus@gmail.com	Oulun yliopisto
Hirvonen	Heikki	heikki.hirvonen@helsinki.fi	Dept. Biosciences, Univ. Helsinki
Hoikkala	Ville	ville.hoikkala@jyu.fi	University of Jyväskylä
Honkola	Terhi	terhi.honkola@utu.fi	University of Turku
Hopkins	Juhani	juhani.hopkins@oulu.fi	University of Oulu
Hoset	Katrine	katrine.hoset@utu.fi	Nord University/University of Turku
Hsu	Bin-Yan	biyahs@utu.fi	University of Turku
Huitu	Otso	otso.huitu@luke.fi	Natural Resources Institute Finland
Hultman	Jenni	Jenni.hultman@gmail.com	University of Helsinki
Huotari	Tea	tea.huotari@helsinki.fi	University of Helsinki
Hurskainen	Sonja	sonja.hurskainen@oulu.fi	University of Oulu
Husby	Arild	arild.husby@helsinki.fi	University of Helsinki
Hutching	Jeffrey	jhutch@dal.ca	Dalhousie University
Huusko	Karoliina	maiya.huusko@oulu.fi	University of Oulu
Hyvönen	Juho	juho.hyvonen@student.oulu.fi	University of Oulu
Häkkilä	Matti	matti.i.hakkila@jyu.fi	University of Jyväskylä
Hämäläinen	Suvi	sphama@utu.fi	University of Turku
Hämäläinen	Reetta	rehamala@student.oulu.fi	Oulun Yliopisto
Höckerstedt	Layla	layla.hockerstedt@helsinki.fi	University of Helsinki
Ikonen	Suvi	suvi.ikonen@helsinki.fi	University of Helsinki
Immonen	Mikko	mikko.v.immonen@helsinki.fi	University of Helsinki

Ismayilzada	Rashad	rashad.ismayilzada@aalto.fi	Aalto University
Ittonen	Mats	mats.ittonen@helsinki.fi	University of Helsinki
Jaatinen	Kim	kim.jaatinen@helsinki.fi	Tvärminne Zoological Station, UH
Jokinen	Jaakko	jaakko.jokinen@student.oulu.fi	University of Oulu
Jokinen	Maarit	maarit.jokinen@helsinki.fi	University of Helsinki
Juutinen	Artti	artti.juutinen@luke.fi	Natural Resources Institute Finland
Jylhä	Maarit	maarit.jylha@helsinki.fi	Department of Biosciences, University of Helsinki
Jylänki	Tanja	tanja.jylanki@oulu.fi	Oulun yliopisto
Juriado	Inga	inga.juriado@helsinki.fi	University of Helsinki
Järvi	Jani	jani.jarvi@helsinki.fi	University of Helsinki
Järvinen	Pauliina	Pauliinajarvinen@gmail.com	University of Turku
Kaasalainen	Ulla	ulla.kaasalainen@helsinki.fi	Finnish Museum of Natural History
Kahilainen	Aapo	aapo.kahilainen@helsinki.fi	University of Helsinki
Kaitala	Arja	arja.kaitala@oulu.fi	University of Oulu
Kallio	Eva	eva.kallio@jyu.fi	University of Jyväskylä
Kankaanpää	Tuomas	tuomas.kankaanpaa@helsinki.fi	University of Helsinki
Kankare	Maaria	maaria.kankare@jyu.fi	University of Jyväskylä
Karanja	Joanne	joannekaranja@gmail.com	university of oulu
Karvinen	Heini	heini.karvinen@helsinki.fi	University of Helsinki
Karvonen	Juha	juha.i.karvonen@helsinki.fi	Faculty of Agriculture and Forestry, Univer
Karvonen	Anssi	anssi.t.karvonen@jyu.fi	University of Jyväskylä
Karvonen	Reena	reena.karvonen@helsinki.fi	Faculty of biosciences
Kauppinen	Miia	miia.kauppinen@oulu.fi	University of Oulu
Kekkonen	Jaana	jaana.kekkonen@helsinki.fi	University of Helsinki, Department of Biosciences
Kekäläinen	Jukka	jukka.s.kekalainen@uef.fi	University of Eastern Finland
Kemppainen	Maiju	kemppainen.maiju@gmail.com	Oulun yliopisto
Keret	Netta	netta.keret@oulu.fi	University of Oulu
Ketola	Tarmo	tketola@jyu.fi	University of Jyväskylä
Khan	Yusuf	yusuf.zhc@gmail.com	University of Helsinki
Kiljunen	Mikko	mikko.j.kiljunen@jyu.fi	University of Jyväskylä
Kisdi	Eva	eva.kisdi@helsinki.fi	University of Helsinki
Klemme	Ines	ines.klemme@jyu.fi	University of Jyväskylä
Koivisto	Elina	elanko@utu.fi	University of Turku
Kokkonen	Eevi	eeviko@uef.fi	University of Eastern Finland
Kokkonen	Tuija	tuija.kokkonen@uniarts.fi	University of the Arts Helsinki
Korpimäki	Erkki	ekorpi@utu.fi	Department of Biology, University of Turku
Koskela	Esa	esa.m.koskela@jyu.fi	University of Jyväskylä
Koski	Tuuli-Marjaana	tmhkos@utu.fi	University of Turku
Koskimäki	Teemu	tepeko@utu.fi	University of Turku
Koskinen	Janne	janne.koskinen@uef.fi	University of Eastern Finland
Kotiaho	Janne	janne.kotiaho@jyu.fi	University of Jyväskylä
Kubitza	Robin	rojeku@utu.fi	Section of Ecology, Department of Biology, University of Turku, Finland
Kuparinen	Anna	anna.kuparinen@helsinki.fi	University of Helsinki
Kurhinen	Juri	kurhinenj@gmail.com	Helsinki University, MRC
Laaksonen	Toni	tokrla@utu.fi	University of Turku
Laanisto	Lauri	laanisto@ut.ee	Estonian University of Life Sciences
Laine	Anna-Liisa	anna-liisa.laine@helsinki.fi	University of Helsinki
Lampinen	Jussi	jilamp@utu.fi	University of Turku

Lansink	Gerhardus	gerard.lansink@student oulu.fi	University of Oulu
Larsen	Ida	ida.larsen@uniarts.fi	University of the Arts Helsinki
Latja	Pirita	pirita.latja@uef.fi	University of Eastern Finland
Le Coeur	Christie	christie.lecoeur@utu.fi	University of Turku
Le Tortorec	Eric	eric.letortorec@jyu.fi	University of Jyväskylä
Lehikoinen	Aija	aija.lehikoinen@student oulu.fi	Oulun yliopisto
Lehmus	Stiina	Stiina.lehmus@student oulu.fi	Oulu university
Lehtimäki	Jenni	jenni.lehtimaki@helsinki.fi	University of Helsinki
Leinonen	Kirsti	kirsti.leinonen@gmail.com	Suomen Ympäristökeskus
Leinonen	Tuomas	tuomas.leinonen@helsinki.fi	University of Helsinki
Lemopoulos	Alexandre	alexlem@uef.fi	University of Eastern Finland
Lempa	Kyösti	kyosti.lempa@aka.fi	Academy of Finland
Leponiemi	Matti	matti.leponiemi@helsinki.fi	HY
Li	Zitong	zitong.li@helsinki.fi	University of Helsinki
Lindén	Andreas	andreas.linden@novia.fi	Novia University of Applied Sciences
Lindholm	Marja	marja.lindholm@oulu.fi	University of Oulu
Lindroos	Louise	louise.lindroos@abo.fi	Åbo Akademi University
Lindstedt-Kareksela	Carita	carita.a.lindstedt@jyu.fi	University of Jyväskylä
Lindström	Leena	leena.m.lindstrom@jyu.fi	University of Jyväskylä
Lindström	Kai	kai.lindstrom@abo.fi	Åbo Akademi University
Lindström	Stafva	Stafva.lindstrom@helsinki.fi	University of Helsinki
Lo	Coong	coong.lo@helsinki.fi	University of Helsinki
Loehr	John	john.loehr@helsinki.fi	Lammi Biological Station / University of Helsinki
Lorenzen	Eline	elinelorenzen@snm.ku.dk	University of Copenhagen
Lummaa	Virpi	virpi.lummaa@gmail.com	University of Turku
Lundberg	Piia	piia.lundberg@helsinki.fi	University of Helsinki
Luong	Thien-Tam	thien-tam.luong@utu.fi	University of Turku
Luosujärvi	Inka	inka.luosujarvi@student oulu.fi	University of Oulu
Lyly	Mari	mari.s.lyly@utu.fi	University of Turku
Lämsä	Juho	juho.lamsa@oulu.fi	University of Oulu
Lönn	Eija	eija.lonn@jyu.fi	University of Jyväskylä
Maliniemi	Tuija	tuija.maliniemi@oulu.fi	University of Oulu
Mannerla	Miia	miia.mannerla@helsinki.fi	Department of Biosciences
Margus	Aigi	aigi.margus@gmail.com	University of Jyväskylä
Marjakangas	Emma-Liina	emma-liina.marjakangas@ntnu.no	Norwegian University of Science and Technology
Markkola	Annamari	Annamari.Markkola@oulu.fi	University of Oulu
Masoero	Giulia	giulia.masoero@gmail.com	University of Turku
Mattila	Tiina	tiina.mattila@oulu.fi	University of Oulu
Meramo	Katarina	katarina.meramo@helsinki.fi	University of Helsinki
Meyke	Evgeniy	evgeniy.meyke@gmail.com	EarthCape OY
Miettinen	Antti	antti.miettinen@student oulu.fi	University of Oulu
Mikkola	Salla	salla.mikkola@outlook.com	University of Turku
Mikkonen	Ninni	ninni.mikkonen@ymparisto.fi	SYKE
Mikkonen	Anne-Mari	anne-mari.h.mikkonen@student.jyu.fi	University of Jyväskylä
Minard	Guillaume	guillaume.minard@helsinki.fi	University of Helsinki
Momigliano	Paolo	paolo.momigliano@helsinki.fi	University of Helsinki
Morosinotto	Chiara	chimor@utu.fi	University of Turku
Moulatlet	Gabriel	gamamo@utu.fi	University of Turku
Moustakas-Verho	Jacqueline	Jacqueline.Moustakas@helsinki.fi	University of Helsinki

Mustonen	Jaani	JB_M@hotmail.fi	University of Oulu
Muurinen	Lauralotta	lauralotta.muurinen@oulu.fi	University of Oulu
Mäkeläinen	Sanna	sanna.makelainen@helsinki.fi	Department of Biosciences
Mäkinen	Julius	julius.makinen@helsinki.fi	University of Helsinki
Mäkipää	Raisa	raisa.makipaa@luke.fi	Natural Resources Institute Finland
Mäntylä	Elina	elkuma@utu.fi	University of Turku
Mönkkönen	Mikko	mikko.monkkonen@jyu.fi	University of Jyväskylä
Nair	Abhilash	abhilash.nair@helsinki.fi	Metapopulation Research Centre
Niemelä	Pekka	pekka.niemela@utu.fi	University of Turku
Niemelä	Jari	jari.niemela@helsinki.fi	University of Helsinki
Nieminen	Eini	eini.m.nieminen@jyu.fi	University of Jyväskylä
Nieminen	Petra	petra.nieminen@elisanet.fi	Oulun yliopisto
Nokelainen	Ossi	ossi.nokelainen@jyu.fi	University of Jyväskylä
Nonaka	Etsuko	etsuko.nonaka@helsinki.fi	University of Helsinki, MRC
Norberg	Anna	anna.norberg@helsinki.fi	Department of Biosciences, University of Helsinki
Norkko	Alf	alf.norkko@helsinki.fi	Tvärminne Zoological Station, University of Helsinki
Norrdahl	Kai	kainor@utu.fi	University of Turku
Norros	Veera	veera.norros@helsinki.fi	Finnish Environment Institute
Numminen	Elina	elina.numminen@helsinki.fi	University of Helsinki
Nurminen	Leena	Leena.nurminen@helsinki.fi	University of Helsinki
Nyberg	Joel	joel.nyberg@student.oulu.fi	University of Oulu
Oksanen	Johannes	lauri.oksanen@student.oulu.fi	University of Oulu
Oldén	Anna	anna.m.olden@jyu.fi	University of Jyväskylä
Olin	Mikko	mikko.olin@helsinki.fi	University of Helsinki, Department of Environmental Sciences
Ollonen	Joni	joni.ollonen@helsinki.fi	Department of Biosciences, HY
O'Reilly	Kira	kira.oreilly@uniarts.fi	University of the Arts Helsinki
Ovaskainen	Otso	otso.ovaskainen@helsinki.fi	University of Helsinki
Paananen	Juuli	juuli.paananen@helsinki.fi	University of Helsinki (MSc student)
Pajulo	Sonja	spajulo@abo.fi	Åbo Akademi
Pajunen	Virpi	virpi.pajunen@helsinki.fi	University of Helsinki
Pajunen	V. Ilmari	ilmari.pajunen@helsinki.fi	Tväminne Zoological Stationn
Parratt	Steve	steven.parratt@helsinki.fi	University of Helsinki
Peltola	Heli	heli.peltola@uef.fi	University of Eastern Finland
Perez	Pablo	papech@utu.fi	University of Turku
Perez Rocha	Mariana	mperezrocha@gmail.com	University of Oulu
Pettay	Jenni	jenni.pettay@utu.fi	Turun Yliopisto
Peura	Maiju	maiju.peura@jyu.fi	University of Jyväskylä
Pikkupeura	Sonja	Sonja.Pikkupeura@student.oulu.fi	University of Oulu
Pitkämäki	Tinja	tievpi@utu.fi	University of Turku
Pitkänen	Juha-Matti	juha-matti.pitkanen@helsinki.fi	University of Helsinki
Pohjanmies	Tähti	tahti.t.pohjanmies@jyu.fi	University of Jyväskylä
Poikela	Noora	noora.p.poikela@student.jyu.fi	University of Jyväskylä
Pokela	Marjut	marjut.pokela@student.oulu.fi	University of Oulu
Poutanen	Jenni	jenni.poutanen@utu.fi	Turun yliopisto
Primmer	Craig	craig.primmer@utu.fi	University of Turku
Puigbo	Pere	pepuav@utu.fi	University of Turku
Pulkkinen	Katja	katja.pulkkinen@jyu.fi	University of Jyväskylä
Purhonen	Jenna	jenna.purhonen@jyu.fi	University of Jyväskylä
Pynnönen	Sari	sari.pynnonen@helsinki.fi	University of Helsinki, Faculty of Agriculture and Forestry
Pöllänen	Antti	antti.pollanen@student.oulu.fi	Oulun yliopisto

Raaska	Laura	laura.raaska@aka.fi	Academy of Finland
Rainio	Kalle	karainio@utu.fi	University of Turku
Rainio	Miia	miikoi@utu.fi	University of Turku
Ramula	Satu	satu.ramula@utu.fi	University of Turku
Raulo	Aura	aura.raulo@zoo.ox.ac.uk	University of Oxford
Rautiainen	Saara	srautiai@student.oulu.fi	Oulun yliopisto/University of Oulu
Raveala	Krista	krista.raveala@helsinki.fi	hy
Repo	Anna	anna.m.repo@jyu.fi	University of Jyväskylä
Riipinen	Katariina	katariina.riipinen@utu.fi	University of Turku
Rikkinen	Jouko	jouko.rikkinen@helsinki.fi	University of Helsinki
Rinta-Runsala	Leena	leena.rinta-runsala@student.oulu.fi	University of Oulu
Rodil	Iván	ivan.rodil@helsinki.fi	Tvärminne Zoological Station (University of Helsinki)
Rojas	Bibiana	bibiana.rojas@jyu.fi	University of Jyväskylä
Rokkanen	Susanna	susanna.rokkanen@helsinki.fi	Helsingin yliopisto
Romppanen	Taina	aurinko.mangusti@gmail.com	Oulu University
Rosa	Elena	elena.rosa@helsinki.fi	University of Helsinki
Rudnäs	Rasmus	rasmusru@gmail.com	University of Oulu
Ruokolainen	Kalle	kalle.ruokolainen@utu.fi	University of Turku
Ruokolainen	Lasse	lasse.ruokolainen@helsinki.fi	University of Helsinki
Ruotsalainen	Anna Liisa	annu.ruotsalainen@oulu.fi	University of Oulu
Rybicki	Joel	joel.rybicki@helsinki.fi	University of Helsinki
Rytteri	Susu	susu.rytteri@helsinki.fi	University of Helsinki
Rönkä	Katja	katja.h.ronka@jyu.fi	University of Jyväskylä
Rönkä	Mia	mia.ronka@utu.fi	University of Turku / University of the Arts
Saarenpää	Sami	sami.saarenpaa@student.oulu.fi	University of Oulu
Safdari	Pezhman	pezhman.safdari@helsinki.fi	University of Helsinki
Salgado	Ana	ana.salgadomaldonado@helsinki.fi	University of Helsinki
Salminen	Tiia	tiia.salminen@helsinki.fi	University of Helsinki
Salminen	Jussi	jussi.salminen@uniarts.fi	University of the Arts Helsinki
Salo	Pälvi	pakisa@utu.fi	University of Turku
Salomaa	Anna	anna.salomaa@helsinki.fi	University of Helsinki
Saloniemi	Irma	irma.saloniemi@utu.fi	Turun yliopisto
Sanchez	Sofia	Sanchez.p.sofia@gmail.com	University of Jyväskylä
Santaharju	Jenni	jenni.leppanen@helsinki.fi	University of Helsinki
Santangeli	Andrea	andrea.santangeli@helsinki.fi	LUOMUS
Sarraude	Tom	tomsar@utu.fi	University of Turku
Sauros	Vilma	v.sauros@hotmail.com	University of Oulu
Schilder	Jos	j.c.schilder@gmail.com	University of Jyväskylä
Schulz	Torsti	torsti.schulz@helsinki.fi	University of Helsinki
Selonen	Vesa	Vessel@utu.fi	University of Turku
Seltmann	Martin	martsel@utu.fi	University of Turku
Seppä	Perttu	perttu.seppa@helsinki.fi	HY/Biotieteet
Sievert	Thorbjörn	thorbjorn.t.sievert@jyu.fi	University of Jyväskylä
Sipari	Saana	saana.m.sipari@jyu.fi	University of Jyväskylä
Sirén	Jukka	jukka.p.siren@helsinki.fi	University of Helsinki
Sirkkiä	Päivi	paivi.sirkkia@helsinki.fi	Finnish Museum of Natural History
Skaldina	Oksana	oksana.skaldina@uef.fi	University of Eastern Finland
Skúlason	Skúli	skuli@holar.is	Hólar University College, Iceland
Soininen	Janne	janne.soininen@helsinki.fi	University of Helsinki

Stenberg	Otto	otto.stenberg@helsinki.fi	Institute of Biotechnology, University of Helsinki
Stålfors	Marco	mtuomine@paju.oulu.fi	University of Oulu
Su	Houyi	hosu@student.jyu.fi	University of Jyväskylä
Suija	Ave	ave.suija@ut.ee	University of Tartu
Sundell	Janne	janne.sundell@helsinki.fi	University of Helsinki, Lammi Biological Station
Sundström	Lotta	liselotte.sundstrom@helsinki.fi	UH Biosciences
Suomenrinne-Nordvik	Anna	anna.suomenrinne-nordvik@helsinki.fi	University of Helsinki
Susi	Hanna	hanna.susi@helsinki.fi	University of Helsinki
Svensson	Linus	director@oikosoffice.lu.se	Nordic Society Oikos Oikos Editorial Office
Syväranta	Jari	jari.syvaranta@uef.fi	Itä-Suomen yliopisto
Szeto	Usko	Usko.szeto@helsinki.fi	University of Helsinki
Säilä	Laura	laura.saila@helsinki.fi	University of Helsinki
Tahvonen	Olli	olli.tahvonen@helsinki.fi	University of Helsinki
Taipale	Sami	sami.taipale@jyu.fi	University of Jyväskylä
Takeshita	Daisuke	daisuke.takeshita@helsinki.fi	University of Helsinki
Talsi	Henrik	henrik.talsi@helsinki.fi	Uni. Helsinki
Taskinen	Jouni	jouni.k.taskinen@jyu.fi	University of Jyväskylä
Terraube	Julien	julien.terraube-monich@helsinki.fi	University of Helsinki
Tervonen	Kaisa	kaisa.i.tervonen@jyu.fi	University of Jyväskylä
Tetorya	Meenakshi	meenakshi.tetorya@south.du.ac.in	University of Delhi
Tikhonov	Gleb	gleb.tikhonov@helsinki.fi	University of Helsinki
Toivio	Viivi	viivi.toivio@helsinki.fi	University of Helsinki
Toivonen	Johanna	jomito@utu.fi	University of Turku
Toivonen	Marjaana	marjaana.toivonen@helsinki.fi	University of Helsinki
Tolonen	Katri	k_tolonen85@hotmail.fi	Finnish Environment Institute
Torppa	Kaisa	torppakaisa@gmail.com	Helsingin yliopisto
Triviño	María	maria.trivino@jyu.fi	University of Jyväskylä, Finland
Truong	Phuoc	phuoc.truong@utu.fi	University of Turku
Tuomi	Maria	maria.tuomi@utu.fi	University of Turku
Tuomisto	Hanna	hanna.tuomisto@utu.fi	University of Turku
Turkia	Tytti	tysisit@utu.fi	University of Turku
Turula	Ari	ari.turula@helsinki.fi	University of Helsinki
Törrönen	Essi	Essi.torronen@student.oulu.fi	Oulun yliopisto
Uusi-Heikkilä	Silva	silva.uusi-heikkila@utu.fi	University of Turku
Uusitalo	Joni	joni.uusitalo@helsinki.fi	University of Helsinki
Vaara	Elina	elina.vaara@helsinki.fi	University of Helsinki, faculty of law
Vakkila	Annu	Annu.Vakkila@student.oulu.fi	University of Oulu
Wallén	Essi	wallen.essi@gmail.com	Oulun yliopisto
Valosaari	Kata-Riina	kata-riina.valosaari@aka.fi	Academy of Finland
Valsta	Lauri	lauri.valsta@helsinki.fi	University of Helsinki
Valtonen	Mia	mia.m.valtonen@helsinki.fi	University of Helsinki
van Cann	Joannes	joannes.vancann@jyu.fi	University of Jyväskylä
van Nouhuys	Saskya	saskya.vannouhuys@helsinki.fi	University of Helsinki
Wang	Jianjun	jianjun.j.wang@helsinki.fi	Department of Geosciences and Geography
Vanhatalo	Jarno	jarno.vanhatalo@helsinki.fi	University of Helsinki
Vasemägi	Anti	antvas@utu.fi	University of Turku
Watts	Phillip	phillip.watts@oulu.fi	University of Oulu
Vaumourin	Elise	elise.vaumourin@helsinki.fi	University of Helsinki

Vehanen	Teppo	teppo.vehanen@luke.fi	Natural Resources Institute Finland
Vesakoski	Outi	outves@utu.fi	University of Turku
Vesala	Risto	risto.vesala@helsinki.fi	University of Helsinki
Vesterinen	Jussi	jussi.p.vesterinen@jyu.fi	University of Jyväskylä
Viljamaa	Sonja	sonjavilja@gmail.com	University of Oulu
Viljanen	Martta	martta.viljanen@helsinki.fi	University of Helsinki
Vilmi	Annika	annika.vilmi@gmail.com	Finnish Environment Institute & University of Oulu
Virsula	Emmi	emmi.virsula@student.oulu.fi	University of Oulu
Virtanen	Tarmo	tarmo.virtanen@helsinki.fi	Dep of Environmental Sciences, UH
Woestmann	Luisa	luisa.woestmann@helsinki.fi	University of Helsinki, MRC
von Numers	Mikael	mnumbers@abo.fi	ÅA, Marin- och miljöbiologi
Vuokare	Kimmo	kimmovuokare@gmail.com	Oulun Yliopisto
Vuoksenmaa	Laura	l.vuoksenmaa@gmail.com	Luonto-liitto
Vähä	Emmi	emmi.vaha@gmail.com	SYKE
Väisänen	Leif	leif.vaisanen@student.oulu.fi	university of Oulu
Wäli	Piippa R.	piippaw@gmail.com	Department of Ecology and Genetics, University of Oulu
Wäli	Pauliina	pauliina.wali@oulu.fi	University of Oulu
Väätäinen	Reetta	reetta.vaatainen@uef.fi	University of Eastern Finland
Yläne	Henni	henni.ylänne@oulu.fi	University of Oulu
Ylönen	Hannu	hannu.j.ylonen@jyu.fi	University of Jyväskylä, Konnevesi Research Station
Zagidullina	Asiia	azagidullina@gmail.com	Saint-Petersburg Forest Research Institute
Zeng	Qingfei	zq-fly@sohu.com	Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences
Zhao	Qian	qian.zhao@helsinki.fi	University of Helsinki
Zuquim	Gabriela	gabriela.zuquim@utu.fi	Turun Yliopisto
Ågren	Anni	anni.i.agren@student.jyu.fi	University of Jyväskylä
Öpik	Maarja	maarja.opik@ut.ee	University of Tartu
Öst	Markus	markus.ost@abo.fi	Åbo Akademi University
Översti	Sanni	sanni.oversti@helsinki.fi	University of Helsinki