NAEM 2020

Netherlands Annual Ecology Meeting

11 & 12 February 2020

Congrescentrum De Werelt, Lunteren

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Programme

Tuesday 11 February

	Main Entrance Hall				
08:30	Registration and coffee in the Lounge and setting up posters				
	Europe Hall				
10:15	**Word of Welcome**				
10:30	**Plenary 1: "Chemical communication – Nature's universal language"** Chemical signals can be perceived by members of the same species, e.g. in the case of alarm, aggregation and sex pheromones, and by other species, such as predators, parasitoids and plants. Species may thus use these signals to find food and mates. To illustrate how chemical signals are shaped by natural and sexual selection, the plenary speakers will highlight their research on chemical signals used by birds to find food and chemical signals used by moths to find potential mates.				
10:30	**1. Following the scent of avian olfaction** Gabrielle Nevitt, Department of Neurobiology, Physiology and Behavior, University of California, Davis, USA				
11.15	**2. Natural and sexual selection on chemical communication signals in moths** Astrid Groot, Department of Evolutionary & Population Biology, University of Amsterdam, the Netherlands				
12:00	**Lunch in the restaurant / 12:30 – 13:15 Postdoc workshop I in Vide Hall**				
	Europe Hall	**Africa Hall**	**Asia 1 Hall**	**Asia 2 Hall**	**Vide Hall**
13:30	**Parallel 1a: Chemical communication – Nature's universal language**	**Parallel 1b: TRENDS in Global Change Research**	**Parallel 1c: Nitrogen in Ecosystems**	**Parallel 1d: Marine Benthic Ecology**	**WORKSHOP 1: Transfer your science into news**
	Conveners: 1. Thomas Blankers (University of Amsterdam) 2. Alexander Haverkamp (Wageningen University & Research)	*Conveners:* 1. Sietze Norder (University of Amsterdam) 2. Alexandra van der Geer (Naturalis Biodiversity Center)	*Conveners:* 1. Rik Veldhuis (University of Groningen) 2. Fons Smolders (Radboud University)	*Conveners:* 1. Anna de Kluijver (Utrecht University) 2. Tanja Stratmann (Utrecht University / MPI Marine Microbiology) 3. Martijn Bart (University of Amsterdam)	*Conveners:* 1. Froukje Rienks (Netherlands Institute of Ecology) 2. Jac Niessen (Wageningen University & Research)
	Chemical communication is crucial in the evolution and ecology of animals and plants, mediating many important interactions such as mating, foraging, and pollination. Yet, to the human observer these signals often remain hidden and elusive. This session will showcase examples of chemical communication, demonstrating the vital role these signals play in the interactions between individuals within and among species as well as across biological kingdoms. We	Ecosystem assemblage and species distributions are drastically modified by human activities. The aim of this session is to address both drivers and consequences of biodiversity change from local to global scales. In addition, we aim to place ecological changes in the Anthropocene within the context of deep-time ecological dynamics.	Since last year the Dutch society has been in a nitrogen crisis. Critical nitrogen deposition loads are exceeded in most of our Natura 2000 areas. Nitrogen deposition causes eutrophication and acidification of the soil leading to a disturbed nutrient balance in the soil. The disturbed nutrient balance causes a cascading effect that alters the form and functioning of our natural areas. In this session we discuss the effects of nitrogen on	Marine benthic hotspots support high levels of biodiversity and provide many goods and services to society. However, many benthic ecosystems are threatened by anthropogenic activities and climate change. To predict and understand how benthic ecosystems respond to future conditions, knowledge on biogeochemical processes and ecological functioning are essential. This session aims to combine studies from organism to ecosystem level on various benthic ecosystems	**WORKSHOP STARTS AT 14:00 hrs:** Good quality science remains the foundation. To be truly successful in a science career, however, it helps if you can also communicate your research to funders and lay public. How do you convey your main message in a press release or on the worldwide web? Bring your own article, dissertation or report,

	therefore encourage talks on the mechanisms and diversity of communication signals across the field of chemical ecology.		soil microorganisms, plants and higher trophic levels.	(e.g., seagrass beds, mangroves, reef-systems) for a broad interdisciplinary exchange.	submerge in the role of science communicator and create at least an intriguing header and first paragraph that will make your science into news. Transforming science into readable news is a profession. However, this workshop will offer a crash course into the do's and don'ts.
13:30	Understanding specificity in plant volatile signalling (Silke Allmann, University of Amsterdam)	Ecological Dynamics in the Anthropocene and Quaternary (Sietze Norder, University of Amsterdam / Universidade de Lisboa)	The impacts of atmospheric nitrogen deposition on natural and semi-natural ecosystems: an overview (Roland Bobbink, B-Ware Research Centre)	Gold rush in the deep sea: Environmental impacts of polymetallic nodule extraction (Tanja Stratmann, Utrecht University / Max Planck Institute for marine microbiology)	
13:50	Finding the needle in a haystack: molecules that elicit butterfly egg-killing in plants (Nina Fatouros, Wageningen University)	Climate-driven range shift of migratory hosts facilitates avian influenza pandemic via crossroads of flyways (Yanjie Xu, Wageningen University)	Mitigating the effects of N deposition in dry heathlands (Maaike Weijters, B-Ware Research Centre)	Deep sea sponge grounds as biogeochemical hotspots (Martijn Bart, University of Amsterdam / Anna de Kluijver, Utrecht University)	
14:10	Microbial volatiles elicit differential olfactory responses in an aphid parasitoid and its hyperparasitoid (Jetske de Boer, Netherlands Institute of Ecology)	Rapid thermophilization of forest understorey plant communities (Sanne Govaert, Ghent University)	Linking nitrogen deposition, producer quality and fauna: what do we know, what can we expect? (Joost Vogels, Bargerveen foundation / Radboud University)	Exploring different sponge engines in coral reefs: Processing of different types of dissolved organic matter (DOM) fuel by high and low microbial abundance sponges (Sara Campana, University of Amsterdam)	
14:30	Short Break				
14:40	*Doublesex* and *transformer* shape sexual dimorphism in the Nasonia antennal lobe (Aidan Williams, Wageningen University)	Deep Macroevolutionary Impact of Humans on New Zealand's Unique Avifauna (Rampal Etienne, University of Groningen)	The effects of abiotic measures and fungi on regeneration of Juniperus communis (Rik Veldhuis, University of Groningen)	Unravelling foreshore ecosystem dynamics: applications for ecosystem-based coastal defense (Beatriz Marin-Diaz, Royal Netherlands Institute for Sea Research)	
15:00	Condition dependence of female choosiness (Naomi Zweerus, University of Amsterdam)	Arthropods in a warming Arctic: new predictors for their advancing phenology (Mikhail Zhemchuzhnikov, Royal Netherlands Institute for Sea Research)	Interactive effects of warming and eutrophication on methane cycling communities in shallow lakes (Thomas Nijman, Radboud University)	Scale-dependent functional patterns in the marine benthos (Olivier Beauchard, Royal Netherlands Institute for Sea Research)	
15:20	Chemical warfare – The role of chemical signals in mosquito ecology and vector control (Jeroen Spitzen, Wageningen University)	Mitigating and adaptive strategies for eutrophication management towards a sustainable Anthropocene (Manqi Chang, Netherlands Institute of Ecology)	Resilience to high N deposition in Grey dunes (H2130): interactions between pH, P nutrition, plant mycorrhizal strategies and soil community composition (Annemieke Kooijman, University of Amsterdam)	Wadden Mosaic: Understanding the ecological functioning of the subtidal Wadden Sea (Oscar Franken, University of Groningen / Royal Netherlands Institute for Sea Research)	
15:40	**Coffee and tea in the lounge**				

16:00	Parallel Session 2				
	Europe Hall	**Africa Hall**	**Asia 1 Hall**	**Asia 2 Hall**	**Vide Hall**
16:00	**Parallel 2a: Movement ecology**	**Parallel 2b: TRENDS in Microbiome Research**	**Parallel 2c: Ecology and Conservation**	**Parallel 2d: Virus Ecology**	
	Conveners: 1. Casper van Leeuwen (Netherlands Institute of Ecology / University of Amsterdam) 2. Allert Bijleveld (Royal Netherlands Institute for Sea Research)	*Conveners:* 1. Ben Oyserman (Netherlands Institute of Ecology) 2. Viviane Cordovez (University of Leiden)	*Conveners:* 1. Ignas Heitkönig (Wageningen University & Research) 2. Rascha Nuijten (Netherlands Institute of Ecology)	*Conveners:* 1. Simone Weidner (Netherlands Institute of Ecology) 2. Adam Ossowicki (IGB Leibniz - Institute of Freshwater Ecology and Inland Fisheries) 3. Jan Dirk van Elsas (University of Groningen)	
	Movement is a key process in ecology, affecting the life history of individuals, populations, communities and ecosystem dynamics. Rapid technological progress in understanding organism movement coincides with a growing need to understand the movement capacity of species facing global changes (e.g. habitat fragmentation, warming, pollution, eutrophication). This session will bring together people studying movement ability and movement requirements of organisms in relation to changing environments. We welcome submissions on all species, habitat types and spatial scales.	Microbiomes have an outsized impact both on a global and local scale. At the global level, microbiomes are one of the primary drivers of ecosystem function and contribute significantly to cycling of nutrients such as nitrogen. On a local scale, microbiome interactions with host organisms may increase the adaptability of the host to stressors such as drought or disease, with direct implications for conservation and movement ecology. This session aims to 1) develop an interdisciplinary exchange of ideas and methods between researchers that investigate the role of microbiomes in ecosystem function and host adaptability, and 2) connect plant and animal researchers with microbiologists to better understand the role of the microbiomes in plant or animal adaptability to global change and stress.	In the current time of rapid global change, application of ecological research is of increasing importance. Biodiversity is under severe threat in many areas of the world and the call for action is becoming stronger. In this session we (1) highlight examples of ecological research that have a positive impact on the conservation of a species, habitat or ecosystem, and (2) explore avenues of increasing the impact of ecological research to halt biodiversity declines and ecological degradation.	Viruses are ubiquitous on Earth, with profound implications for host fitness and ecosystem function as well as for crop, livestock and human health. Much is known from particular disciplines such as aquatic microbiology and plant pathology, while new research frontiers are emerging in other systems, such as the soil. This session will foster exchange between these perspectives and integration with broader ecological research. All submissions that consider viruses in their ecological context are welcomed.	
16:00	Explaining changes in annual cycle movements in response to climate change (Christiaan Both, University of Groningen)	Linking host genotype and microbiome (Ben Oyserman, Netherlands Institute of Ecology)	Conservation attention necessary across at least 44% of Earth's terrestrial area to safeguard biodiversity (James Allan, University of Amsterdam)	Computational and experimental approaches to determine bacteriophage host-range (Bas Dutilh, Utrecht University)	

16:20	Bill length and sex shapes diet, fuel deposition and migration timing in a long-distance migrant (Thomas Lameris, Royal Netherlands Institute for Sea Research)	Combined effects of light and nutrient availability on freshwater macrophyte quality and its associated microbial biofilm (Mandy Velthuis, Leibniz-Institute of Freshwater Ecology and Inland Fisheries)	The afterlife of wood (Shanshan Yang, Wageningen University)	Warming advances virus population dynamics in a temperate freshwater plankton community (Dedmer van de Waal, Netherlands Institute of Ecology)	
16:40	Barnacle geese rapidly adjust migratory habits to climate change through social learning (Thomas Oudman, University of St Andrews)	Wheat rhizosphere bacterial communities and protection against soil-borne pathogen (Lilian S. Abreu S. Costa, Embrapa Environment, Brazil)	Mitigating salamander declines: disentangling the mechanisms driving population persistence and disease invasion (Jesse Erens, Ghent University)	The dynamics and diversity of the mycosphere virome (Akbar Adjie Pratama, University of Groningen)	
17:00	Short break				
17:10	Collective spatial segregation between non territorial central-place foragers (Geert Aarts, Royal Netherlands Institute for Sea Research)	Can we find clues in the fecal microbiome of laying chickens that we can relate to exposure to wild birds and their potential pathogens? (Janneke Schreuder, Utrecht University)	The impact of protected areas and derogation shooting on the foraging behaviour of barnacle geese in Friesland, Netherlands: a modelling study (Monique de Jager, Netherlands Institute of Ecology)	Phylogeographic and phylodynamic approaches to explore viral ecology (Sebastian Lequime, KU Leuven)	
17:30	Spatiotemporal variation in disturbance impacts derived from combined tracking of aircraft and shorebirds (Henk-Jan van der Kolk, Netherlands Institute of Ecology)	Seasonal variation in the gut microbiome of homing pigeons (Maurine W. Dietz, University of Groningen)	Contrasting microclimates among hedgerows and woodlands across temperate Europe (Thomas Vanneste, Ghent University)	Here to stay: Usutu virus activity in the Netherlands (Henk van der Jeugd, Netherlands Institute of Ecology)	
17:50	Observing and modeling regional migratory patterns of birds using meteorological radar (Bart Kranstauber, University of Amsterdam)	Speeding-up nature restoration with soil microbiome steering: a case study of bottom-up and top-down regulation of microbial communities (Elly Morriën, University of Amsterdam)	What can we learn from the Chinese dryland restoration projects? (Yanning Qiu, Wageningen University)	A new virus of Arabidopsis widespread in geographically dispersed ecotypes (René van der Vlugt, Wageningen University)	
18:10	**Drinks in the Lounge and from 18:30 onwards dinner in the restaurant**				
19:30	**Poster session 1:** Odd-numbered posters, which are linked to the sessions of the day, are presented and discussed				
21:00	**Evening Programme: Movie Screening of "The Serengeti Rules" with an introduction and synthesis provided by Prof. Hans de Kroon (Radboud University, Nijmegen, the Netherlands**. (Europe Hall)				

Wednesday 12 February

07:30	Breakfast in the restaurant				
08:00	Registration for those coming on Day 2 only				
08:30	**Parallel Session 3**				
	Europe Hall	**Africa Hall**	**Asia 1 Hall**	**Asia 2 Hall**	**Vide Hall**
08:30	**Parallel 3a: Herbivores and Ecosystem Dynamics**	**Parallel 3b: TRENDS in Eco-Evo Dynamics**	**Parallel 3c: Network Analysis in Ecology**	**Parallel 3d: Plastics in the Environment**	
	Conveners: 1. Judith Sitters (Vrije Universiteit Brussel) 2. Ciska Veen (Netherlands Institute of Ecology)	*Conveners:* 1. Aafke Oldenbeuving (Naturalis Biodiversity Center) 2. Jelle Zandveld (University of Amsterdam) 3. Joost van den Heuvel (Wageningen University & Research)	*Conveners:* 1. Pariya Behrouzi (Wageningen University & Research) 2. Romain Frelat (Wageningen University & Reserarch) 3. Lia Hemerik (Wageningen University & Research)	*Conveners:* 1. Oscar Franken (Vrije Universiteit Amsterdam) 2. Esperanza Huerta Lwanga (Wageningen University & Research)	
	Herbivores are major drivers of the structure and functioning of terrestrial and aquatic ecosystems. They exert strong influences on plant communities, nutrient cycles and soil/water properties, which all have an impact on the ecology of other organisms and ecosystem processes. This session aims to bring scientists together who are working on a range of herbivores, from invertebrates to elephants, and their impacts on biodiversity and ecosystem functioning.	In nature organisms adapt to all environmental selection pressures that are encountered. While one selection pressure increases a trait, another might decrease it, leading to optimal life histories. Similar phenomena exist at the individual species level for physiological and / or genetic trade-offs. This session aims to discuss the trends in evolutionary dynamics by comparing the dynamics on different levels of organisation.	Networks are a powerful tool to represent complex realities and network analysis is applied in a large diversity of fields in ecology, with for example protein networks, pollination networks or food webs. Understanding the structure of networks can help revealing stabilizing mechanisms of communities. This theme session provides an opportunity to examine recent methodological advances in as well as new applications of network analysis in ecology.	Plastic pollution has recently gained a lot of media attention. Yet, the effects these plastics may have in both aquatic and terrestrial ecosystems are still largely unknown. Breakdown of larger particles can result in the formation of micro- and nano-plastics, which may affect species in direct and indirect ways. This session aims at bringing together and synthesizing the current ecological knowledge on the effects of plastic pollution in a wide range of ecosystems.	
08:30	Impact of herbivores on alternative stable states of ecosystems (Liesbeth Bakker, Netherlands Institute of Ecology)	Eco-evolutionary dynamics across scales in a fast-changing world (Martijn Egas, University of Amsterdam)	A biogeochemical network analysis of a common deep-sea sponge (Anna de Kluijver, Utrecht University)	Plastics in the environment – Session introduction and overview (Oscar Franken, Vrije Universiteit Amsterdam & Esperanza Huerta Lwanga, Wageningen University)	
08:50	Anthropogenic fear landscapes influence tree recruitment and tick distribution (Bjorn Mols, University of Groningen)	Coping with the present while preparing for the future: developmental plasticity in bulb mite weapons (Flor Rhebergen, University of Amsterdam)	Carbon processing differs between sandy and silty sites at Bourgneuf Bay (Tanja Stratmann, Utrecht University / MPI for Marine Microbiology)	Effects of plastic mulch film residues on wheat growth and rhizosphere microbiome (Yueling Qi, Wageningen University)	

09:10	The importance of climatic extremes on plant-insect herbivore interactions (Jeff Harvey, Netherlands Institute of Ecology)	Long-term community dynamics in bacterial ecosystems (Sijmen Schoustra, Wageningen University)	Integrating qualitative and quantitative descriptors reveals temporal dynamics of food web (Romain Frelat, Wageningen University)	Exploring the impacts of polyester fibers and tire wear particles on soil invertebrates (Salla Selonen, Vrije Universiteit Amsterdam)	
09:30	Short Break				
09:40	Large herbivores and palms structure soil nutrient cycling in a neotropical frugivore dominated rainforest (Nacho Villar, Universidade Estadual Paulista / Netherlands Institute of Ecology)	Adaptation and adaptive control in periods of environmental change (Tom Van Dooren, Centre National de la Recherche Scientifique / Sorbonne University / Naturalis Biodiversity Center)	Evaluating stability of energy-flux food-web models (Daniëlle de Jonge, Royal Netherlands Institute for Sea Research / University of Groningen)	Assessing the Fate of Marine Plastics: Colonization and density change (Erik Zetter, Royal Netherlands Institute for Sea Research / Utrecht University)	
10:00	Impediments affect deer foraging decisions and sapling performance (Annelies van Ginkel, University of Groningen)	Functional traits shape liana strategies and niches (Qi Liu, Wageningen University)	Microbial network analysis – where do we stand? (Karoline Faust, KU Leuven)	Accumulation, distribution and composition characteristics of macro-micro plastic particles in different mulching farmlands, Northwest China (Fanrong Meng, Wageningen University)	
10:20	Zooplankton grazing efficiency is mediated by shelter: an enclosure study on the Marker Wadden (Hui Jin, Netherlands Institute of Ecology)	Resonance revisited: life-history evolution and food web stability in fluctuating environments (Charlotte de Vries, University of Zürich)	Learning from microbial association networks through clusters and conserved patterns (Lisa Röttjers, KU Leuven)	Plastic mulch in agriculture: the case of low density polyethylene and its interactions with pesticides and soil microbiota (Nicolas Beriot, Wageningen University)	
10:40	**Coffee and tea in the lounge**				
11:00	• **Poster Session 2:** Even-numbered posters, which are linked to the sessions of the day, are presented and discussed • **Postdoc Workshop II** in Vide Hall up to 13:15 with a short break to get lunch				
12:30	**Lunch in the restaurant**				
13:30	**Parallel Session 4**				
	Europe Hall	**Africa Hall**	**Asia 1 Hall**	**Asia 2 Hall**	**Vide Hall**
13:30	**Parallel 4a: Soil Organic Matter in A changing environment**	**Parallel 4b: TRENDS in Biodiversity Research**	**Parallel 4c: Recent Advances and Critical Topics in Reproductive Biology**	**Parallel 4d: Ecology of Social Behaviour**	**WORKSHOP 2: Transfer your science into news**
	Conveners: 1. Maaike van Agtmaal (Louis Bolk Institute) 2. Mariet Hefting (Utrecht University	*Conveners:* 1. Patrick Jansen (Wageningen University & Research) 2. Koos Biesmeijer (Naturalis Biodiversity Center)	*Conveners:* 1. Melissah Row (Netherlands Institute of Ecology) 2. Lyanne Brouwer (Radboud University) 3. Yumi Nakadera (Vrije Universiteit Amsterdam) 4. Joris M. Koene (Vrije Universiteit Amsterdam)	*Conveners:* 1. Martijn Hammers (University of Groningen) 2. Sjouke Kingma (Wageningen University & Research)	*Conveners:* 1. Aafke Kok, Gert van Maanen & Steijn van Schie (Bionieuws, the Dutch biweekly for biologists

	Soil organic matter (SOM) is crucial in many soil-associated ecosystem services. SOM facilitates water retention, nutrient cycling, greenhouse gas mitigation and structural stability of soils. Climate change and land use intensification have major impacts on SOM stability and composition, due to direct changes in environmental conditions and indirect changes in vegetation. This session welcomes research from both natural and managed systems on SOM dynamics in a changing world in relation to soil ecosystems services.	Decline of biodiversity has quickly developed into one of the most urgent problems of our time, and has been identified as an urgent threat by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). The Netherlands, with its high human population density and its intense agriculture and polluting industries, is one of the countries in which these problems are relatively prominent. This session deals with research on trends in biodiversity. Talks may cover recent discoveries, methods, technologies and approaches in biodiversity research, including both the measurement of trends, the identification of the underlying drivers, and the evaluation of potential solutions.	Knowledge of reproductive biology is crucial to our understanding of organismal ecology and evolution. Such knowledge is particularly pertinent in modern times given that rapid environmental changes, such as increasing temperatures and urbanization, are negatively impacting biodiversity on a global scale. This session aims to highlight recent advances in our knowledge of reproductive tactics and processes with a particular focus on understudied taxa, as well highlight the impacts of environmental change on reproductive traits related to fitness in order to stimulate research on these topics.	Most organisms live in a social environment, and many aspects of their lives are affected by social interactions. Studying how ecological conditions affect cooperation and conflict between individuals is important for understanding life-history evolution, population dynamics and conservation. This session aims to discuss (1) how ecological conditions shape social behaviour and (2) highlight the importance of considering social behaviour in ecological studies.	**WORKSHOP STARTS AT 14:00 hrs**: Good quality science remains the foundation. To be truly successful in a science career, however, it helps if you can also communicate your research to funders and lay public. How do you convey your main message in a press release or on the worldwide web? Bring your own article, dissertation or report, submerge in the role of science communicator and create at least an intriguing header and first paragraph that will make your science into news. Transforming science into readable news is a profession. However, this workshop will offer a crash course into the do's and don'ts.
13:30	Global mycorrhizal plant distribution linked to terrestrial carbon stocks (Nadejda Soudzilovskaia, Leiden University)	Flower-rich dikes as a valuable habitat for wild bees; a case study from the river Waal, the Netherlands (Constant Swinkels, Radboud University)	Complex effects of multisensory pollution on sexual communication (Andrew Cronin, Vrije Universiteit Amsterdam)	Ecology of social behaviour (Martijn Hammers, University of Groningen)	
13:50	Ectomycorrhizal necromass decomposition: how interactions between cell wall chemical components affect the degradation process. (Riccardo Mancinelli, Leiden University)	Aerial arthropod abundance and diversity in strip cropping systems (Fogelina Cuperus, Wageningen University)	Mechanisms underlying the seasonal onset of reproduction in a wild songbird (Melanie Lindner, Netherlands Institute of Ecology / University of Groningen)	Neurogenetic dissection of group formation: integrating cues from food, friends and foes (Thomas Verschut, University of Groningen)	
14:10	How local and continental drivers influence carbon stocks in forest edges across Europe. (Camille Meeuwsen, Ghent University)	Fine-scale habitat niches of wetland birds derived from country-wide Airborne Laser Scanning data (Zsófia Koma, University of Amsterdam)	Temperatures that sterilise males predict global distributions of Drosophila species (Steven Parratt, University of Liverpool)	Habitat fragmentation affects group living in an Afrotropical cooperative breeder (Laurence Cousseau, Ghent University)	
14:30	Short Break				
14:40	Sensitivity of labile carbon fractions to tillage and organic matter management and their potential as comprehensive soil quality indicators across pedoclimatic conditions in Europe (Giulia Bongiorno, Wageningen University)	Analysis of a coastal North Sea fish community: comparison of aquatic environmental DNA concentrations to fish catches (Judith van Bleijswijk, Royal Netherlands Institute for Sea Research)	Mate choice and reproductive success in a warming planet (Valentina Zizzari, University of Koblenz-Landau)	Love thy neighbour, or not? – Spatial variation of density-dependent nest success in Eurasian oystercatcher (Magali Frauendorf, Netherlands Institute of Ecology & Centre for Avian Population Studies)	

15:00	Degradation of SOM in cultivated peat soils, why is there no stabilization? (Mariet Hefting, Utrecht University)	Application of metabarcoding to determine the contribution of arthropod taxa to avian diets: validation with recorded diets (Yvonne I. Verkuil, University of Groningen)	The mediating role of the placenta in antidepressant exposure in the live-bearing fish family Poeciliidae (Laura Staal, University of Groningen)	Recipient directed food calls in chimpanzees (Anne Marijke Schel, Utrecht University)	
15:20	Organic matter in peatlands: effects of land use and management measures (Joachim Deru, Louis Bolk Institute)	Towards open biodiversity data (Niels Raes, Netherlands Biodiversity Information Facility)	Reproductive ruin in the modern world? (Melissah Rowe, Netherlands Institute of Ecology)	Communal breeding and cooperation in Seychelles warblers is associated with nest predation risk, not survival benefits and food availability (Sjouke Anne Kingma, Wageningen University)	
15:40	**Coffee and tea in the lounge**				
16:00	**Europe Hall**				
16:00	**Plenary 2: "Soil Carbon Dynamics in a Changing World"** We show how the global carbon cycle has changed due to changes in land management and climate change. These changes have a severe impact on atmospheric carbon concentrations and thus feed back on the global climate. Next, we explore how land management and natural processes can help to increase soil carbon storage and thereby mitigate climate change. Ecological knowledge of the underlying processes is pivotal to do this successfully, but this cannot be achieved without involving economists and social scientists.				
16:00	**1. Storing carbon in managed lands: an ecosystem perspective** Henry Janzen, Lethbridge Research and Development Centre, part of Agriculture and Agri-Food Canada				
16:45	**2. Soil carbon dynamics in a changing climate** Rien Aerts, Department of Ecological Sciences, Vrije Universiteit Amsterdam, the Netherlands				
13:30	**Awards and Closing Ceremony**				
18:00	**Farewell drinks**				
18:30	**Dinner and NERN board meeting**				
19:30	**End / Travel Home** (Shuttle available between Conference Centre and Lunteren Station)				

NAEM 2020

Presentation Abstracts

Plenary Session 1

Chemical communication – Nature's universal language

Chemical signals can be perceived by members of the same species, e.g. in the case of alarm, aggregation and sex pheromones, and by other species, such as predators, parasitoids and plants. Species may thus use these signals to find food and mates. To illustrate how chemical signals are shaped by natural and sexual selection, the plenary speakers will highlight their research on chemical signals used by birds to find food and chemical signals used by moths to find potential mates.

1. Following the scent and avian olfaction

(Gabrielle Nevitt, University of California)

When John James Audubon proclaimed that birds lacked a sense of smell, the study of avian olfaction was doomed to suffer ridicule by ornithology text books for years to come. In recent years, ornithologists have renewed their interest into the sense of smell in birds leading to a new appreciation of their chemical ecology. The tubenosed seabirds (petrels and albatrosses) of the order Procellariiformes have among the most impressive olfactory abilities of any animal on earth. Species within this order spend most of their lives flying over the world's oceans, returning to land each year or every other year, to breed and rear a single offspring. They tend to partner for life and show strong nest-site fidelity between breeding seasons. Much of my research career has focused on elucidating how procellariform species use olfaction to perform behaviors ranging from foraging and navigation to mate choice and individual recognition. My presentation will touch on some of our recent findings and hopefully convince you that olfaction is a rich field of study, and that questions related to sensory ecology are both important and applicable to scientific inquiry into the biology and conservation.

2. Natural and sexual selection on chemical communication signals in moths

(Astrid Groot, University of Amsterdam)

In this era of climate change and chemical pollution, where the number and abundance of insect species decline rapidly worldwide, we need to understand the causes and consequences of variation in insect chemical communication, as this plays a central role in the food web of life. Chemical communication in moths is thoroughly studied, because moths are one of the most diverse groups of animals (~130.000 species), with well-defined sex pheromones, which are used in pest management to monitor and minimize caterpillar damage in agriculture. Evolution of moth chemical communication systems may occur through species interactions at multiple levels: Closely related species with similar mating signals may cause communication interference, secondary metabolites of host plants may cause stress, and pathogens and parasites may directly or indirectly affect sexual signals and responses. Through a combination of genetic analyses and behavioral lab and field experiments, we investigate the genetic changes underlying sexual interactions that lead to population divergence [1,2], measure the ecological selection forces affecting sexual attraction [3,4], including parasites and pathogens [5], and extrapolate changes at micro-evolutionary scale to macro-evolutionary biodiversity patterns [6]. Our findings are discussed in the context of climate change [7] and chemical pollution.

1) Lassance et al 2010, *Nature 466;*
2) Koutroumpa et al 2016, *PNAS 113;*
3) Groot et al 2006, *PNAS 103;*
4) Van Wijk et al 2017, *Scientific Reports 7;*
5) Barthel et al 2015, *BMC Evol Biol 15;*
6) Groot et al 2016, *Annu Rev Entomol 6;.*
7) Groot & Zizzari 2019, Anim Biol 69.

Plenary Session 2

Soil Carbon Dynamics in a Changing World

We show how the global carbon cycle has changed due to changes in land management and climate change. These changes have a severe impact on atmospheric carbon concentrations and thus feedback on the global climate. Next, we explore how land management and natural processes can help to increase soil carbon storage and thereby mitigate climate change. Ecological knowledge of the underlying processes is pivotal to do this successfully, but this cannot be achieved without involving economists and social scientists.

1. Storing carbon in managed lands: an ecosystem perspective

(Henry Janzen, Agriculture and Agri-Food Canada)

Sequestering carbon (C) in soils to mitigate climate change has become an alluring prospect. Such C storage, however, is an outcome not of soil processes alone, but rather of all interwoven fluxes in the ecosystem, enfolding all biota and their interactions with each other and their environment. Notably, it is photosynthesis that captures solar energy, which then flows throughout the food web as C-rich molecules, fueling land's biota. In this presentation, I review briefly the C cycle, globally and in local ecosystems, and from that background, ponder how a wider land perspective may guide us in enhancing soil C stores for manifold benefits, including climate mitigation. What limits soil C gains in ecosystems, and how much can we store? What are the trade-offs involved in sequestering C? What practices best promote soil C gain, and preserve C already stored? How can we better follow C flows through entire ecosystems, including also people? I ponder these and other questions, focusing primarily on agricultural ecosystems, as a way of stimulating fruitful conversation. In the end, optimizing soil C dynamics for multiple benefits will depend on seeing the entire ecosystem through a transdisciplinary lens. In this way, the story of C atoms flowing through lands can become a unifying thread weaving together our various disciplines into approaches, tuned to individual ecosystems, that best sustain the land and help assuage the threat of climate change.

2. Soil carbon dynamics in a changing climate

(Rien Aerts, Vrije Universiteit Amsterdam)

World-wide, soils store about twice as much carbon than the atmosphere and the fluxes of carbon between these two compartments are major fluxes within the global carbon cycle. During the past 150 years the combustion of fossils fuels has caused a strong and continuous increase of atmospheric CO_2 concentrations, despite the fact that this flux is only 5% of the total flux to the atmosphere, while the remaining 95% consists of natural fluxes. These higher atmospheric CO_2 concentrations have led to global warming, which has in turn led to significant increases of carbon fluxes between soils and the atmosphere. Here I will give an overview of the effects of higher temperatures on carbon dynamics of natural ecosystems and the resulting positive feedbacks to climate warming. Moreover, I will elaborate on the effects of climate warming on wildfires that nowadays cause a second positive feedback on climate warming due to the fast emission of CO_2 that had been stored in soil organic matter and vegetation. Finally, I will discuss how land management measures in the Netherlands may or may not contribute to climate mitigation by storing more carbon.

Parallel Session 1

1a: Chemical communication – Nature's universal language

Conveners: Thomas Blankers (University of Amsterdam)
Alexander Haverkamp (Wageningen University & Research)

1. Understanding specificity in plant volatile signalling

Silke Allman
University of Amsterdam

Plants under attack are able to emit large amounts of volatiles in the air. These volatiles can profoundly change the behavior of nearby insects and plants, but the underlying mechanisms are largely unknown. We focus on a group of plant volatiles that are emitted the earliest upon herbivory, the so-called "green leaf volatiles". We have discovered enzymes, present in plants and insects, that profoundly affect ecological interactions by converting the highly abundant green leaf volatile Z-3-hexenal into E-2-hexenal. These two compounds, as well as their derivatives, have distinct effects on the behavior of herbivorous and predacious insects as well as on the metabolism of plants. In this presentation I will provide an overview of some recent insights in green leaf volatile production and the importance of specificity for volatile signaling.

2. Finding the needle in a haystack: molecules that elicit butterfly egg-killing in plants

Lotte Caarls, Niccolo, Bassetti, M. Eric Schranz, Nina Fatouros
Wageningen University & Research

Plants can defend against insect eggs deposited on their leaves by e.g. the formation of necrotic tissue underneath the eggs. Several brassicaceous plants, including the annual weed, *Brassica nigra*, show an egg-killing necrosis to cabbage white butterfly (*Pieris sp*.) eggs in nature. Knowledge on egg-associated molecular patterns (EAMPs) or elicitors inducing egg-killing is limited and no bonafide egg receptor has been found so far. We aim to isolate and identify the EAMPs that triggers egg-killing necrosis in *B. nigra*. Wash of *Pieris* eggs can elicit a similar response as the eggs themselves. Washes of four tested Pierid species gave similar responses, suggesting that the elicitor is on secretions covering the eggs or egg glue released with the eggs, and shared between Pieridae. To identify the elicitor, we analysed the chemistry of egg washes by LC/MS, and compared inducing and non-inducing washes. Furthermore, active washes were fractionated. Seven compounds are shared between all inducing washes and in the active fraction, and are thus good candidates as necrosis-inducing EAMPs. Validation of these compounds is still ongoing and when accomplished will further aid us in identifying the corresponding plant receptor of this egg-killing response.

3. Microbial volatiles elicit differential olfactory responses in an aphid parasitoid and its hyperparasitoid

Jetske G. de Boer, Tim Goelen, Hans Jacquemyn, Bart Lievens
Netherlands Institute of Ecology

Chemical cues are key to mating and foraging behavior in many insect species. To date, most research has focused on (host) plants and insects as the source of these cues, while microbial volatiles have been overlooked until recently. In this study, we tested whether volatiles produced by bacteria influence olfactory behavior of the aphid parasitoid *Aphidius colemani*. We also investigated the behavior of the hyperparasitoid *Dendrocerus aphidum*, which is a natural enemy of the aphid parasitoid. Combining volatile odor profiles of specific bacterial isolates with olfactory responses of these third and fourth trophic level parasitoids, allowed us to assess which compound classes mediate their behavior. Our results indicate that microbial volatiles are an important component of multitrophic interactions between plants and insects. We also discuss the possible applications of these microbial volatiles to increase the effectiveness of biological control of aphids.

4. *Doublesex* and *transformer* shape sexual dimorphism in the *Nasonia* antennal lobe

Aidan T. Williams, Hans Smid and Eveline C. Verhulst
Wageningen University & Research

The morphology and structure of the insect olfactory system provide insight into the ecological relevance of odours and how they influence behaviour. Our study focused on the role the conserved transcription factors *Doublesex* and *Transformer* have in regulating sexual dimorphism in insect olfaction. We used the model parasitoid wasp *Nasonia vitripennis* to study sexual dimorphism in the organization of olfactory glomeruli in the antennal lobe. Anterograde tracing of sensory neurons revealed a vast number of sex-specific glomeruli in *Nasonia* males and females. *Doublesex* and *Transformer* were subsequently silenced with dsRNA in males and females respectively and glomerular organization was compared with wild-type specimens. The results of our study confirmed for the first time that sexual dimorphism exists in the antennal lobe of a parasitoid wasp and that sex-specific differences are regulated by conserved elements of the sex-determination pathway. These results open up many interesting avenues to investigate the sex-specific regulation of target genes during brain development, sex-specific neural circuitries for pheromone signaling as well as evolutionary transitions in the chemical communication of an established parasitoid model system.

5. Condition dependence of female choosiness

Naomi L. Zweerus, Michiel van Wijk, Coby Schal, Astrid T. Groot
University of Amsterdam

Individuals may modify mate choice based on experience throughout their lifetime. For example, experienced individuals are likely to spend more time and effort to assess traits of prospective partners than virgins, because the top priority of virgins is to secure a mate. In short-lived animals, like the moth *Heliothis virescens*, one mating provides enough sperm to inseminate all eggs, and mated females may be more choosy because stored sperm from the first mating guarantees fitness and relaxes the costs of being choosy. We investigated the extent to which female mating status alters her choosiness. By filming and quantifying signalling activity, mating latency, and mate preferences of virgin and mated females, we delineated how mating status affects female mate choice. We also assessed whether close-range sexual signals emitted by males affect female mate choice. We found that virgin females engaged more in signalling and mated earlier compared to previously mated females. Moreover, mated females showed a stronger preference for high quality males than virgin females. However, females did not appear to base their choice on the male pheromone. These results illustrate how ecological and physiological factors interplay with mate choice and thus create complex interactions in sexual communication.

6. Chemical warfare – The role of chemical signals in mosquito ecology and vector control

Jeroen Spitzen
Wageningen University & Research

Mosquitoes' flight strategies are odour driven. To successfully reproduce, they have to locate energy resources, a partner to mate, a blood source to develop eggs and an oviposition site to deposit them. Besides odours, cues such as visual, heat or wind direction, also affect successful source location. The relative importance of each cue is highly species specific. The important role of carbon dioxide (CO_2) for example, is different between mosquito species, depending on their host preferences. The malaria mosquito *An. gambiae* s.s. typically shows upwind host-seeking behaviour, even in the absence of odour cues, which seems a different strategy to locate hosts compared to other species like *Aedes aegypti*. Bio-assays using dual-choice olfactometers, traps, semi-field containment facilities, have contributed to our understanding of (host-) preferences of mosquitoes and the role of specific target site cues. Descriptions of flight behaviour, in relation to the chemical signals they are exposed to, benefit our knowledge on mosquito behavioural ecology. With that, vector-intervention tools such as odour-baited traps or house improvements can be further developed and optimized. By means of automated video tracking we have a better understanding of the integration of different cues and how they affect the approach of mosquitoes to reach their target site.

1b: TRENDS in Global Change Research

Conveners: Sietze Norder (University of Amsterdam)
Alexandra van der Geer (Naturalis Biodiversity Center)

1. Ecological Dynamics in the Anthropocene and Quaternary

Sietze Norder, Alexandra van der Geer
University of Amsterdam / Naturalis Biodiversity Center

The realization that human activities have a major influence on ecosystems from local to global scales has given rise to the concept of the Anthropocene. As a consequence of human activities, biodiversity patterns and processes have changed dramatically. Rates of species extinction are currently outpacing background rates to such an extent that we are heading towards a sixth global mass extinction. On the other hand, in some locations species richness increases due to the (intentional and accidental) introductions of exotic species. Human activities might even modify evolutionary trajectories of species by changing their evolutionary and ecological opportunities. While the influence of human activities on biodiversity is clearly significant, it is not always clear how the rate and magnitude of change differ from pre-human dynamics. Therefore, the aim of this session is twofold: 1) to place ecological changes in the Anthropocene within the context of deep-time ecological and evolutionary dynamics, and 2) to address the drivers and consequences of biodiversity change from local to global scales.

2. Climate-driven range shift of migratory hosts facilitates avian influenza pandemic via crossroads of flyways

Yanjie Xu, Henk van der Jeugd, Yali Si, Herbert Prins, Matthieu Guillemain, Alain Caizergues, Zhouyuan Li, Jasper Eikelboom, Chi Xu, Kasper Thorup, Jan von Rönn, Peng Gong, Willem de Boer
Wageningen University & Research

Avian influenza viruses travel around the world through the crossroads of the flyways that migratory birds use. Identification of these crossroads, i.e., locations where different populations mix and viruses can jump hosts, are crucial for restraining long-distance virus transmission by migratory hosts. However, little is known about the distribution of these crossroads, and how global changes shift the intensity of crossing. With a module detection approach and bridging centrality measurement from network theory, we mapped intra- and inter-species crossroads for 52 migratory waterfowl species in Eurasia and North America, as well as their changes from 1950 to 2019. Intra-species crossroads mainly occur in the northernmost and southernmost areas in North America, but in the eastern areas of Eurasia. Several susceptible species, i.e., northern pintail, Eurasian wigeon, blue-winged teal, and Eurasian teal, bridge the flyways of other species more. North American species cross more in the last decades both within and across species. A clear pattern of a northward shift in North American species explains the increase in crossing intensity. A range shift of migratory hosts driven by climate warming may thus result in an increasing risk of long-distance transmissions and broad-scale outbreaks of infectious diseases.

3. Rapid thermophilization of forest understorey plant communities

Sanne Govaert, Pieter Vangansbeke, Kris Verheyen, Pieter De Frenne
Ghent University

An ever increasing mixture of anthropogenic stressors is acting on forests worldwide. Among these are eutrophication, climate change and intensified forest management (opening up the canopy), all three impacting ecosystem functions and biodiversity. In temperate forests, 80% of the biodiversity is represented by the understorey plant community. The understorey plays key roles in several ecosystem functions such as tree generation, nutrient cycling and carbon dynamics. Observational data on the effects of these stressors on the understorey is available and well-studied. However, long term experimental data focussing on the interactive effects of these anthropogenic stressors is lacking. This kind of data is needed to soundly inform forest managers how best to adapt to climate change to conserve forest biodiversity.
Here, we studied the influence of enhanced nitrogen inputs, passive warming and light addition (as a proxy for management-driven understorey light availability) on understorey plant communities of temperate broadleaved forest. We report eight years of post-treatment data. Plant communities shifted in this relative short time scale towards more warm-adapted and less cold-adapted communities. What is interesting is that we find a shift in all treatments as well as control plots.

4. Deep Macroevolutionary Impact of Humans on New Zealand's Unique Avifauna

Luis Valente, Rampal Etienne, Juan Garcia-R.
University of Groningen

Islands are at the frontline of the anthropogenic extinction crisis. A vast number of island birds have gone extinct since human colonization, and an important proportion is currently threatened with extinction. While the number of lost or threatened avian species has often been quantified, the macroevolutionary consequences of human impact on island biodiversity have rarely been measured. Here, we estimate the amount of evolutionary time that has been lost or is under threat due to anthropogenic activity in a classic example, New Zealand. Half of its bird taxa have gone extinct since humans arrived and many are threatened, including lineages forming highly distinct branches in the avian tree of life. Using paleontological and ancient DNA information, we compiled a dated phylogenetic dataset for New Zealand's terrestrial avifauna. We extend the method DAISIE developed for island biogeography to allow for the fact that many of New Zealand's birds are evolutionarily isolated and use it to estimate natural rates of speciation, extinction, and colonization. Simulating under a range of human-induced extinction scenarios, we find that it would take approximately 50 million years (Ma) to recover the number of species lost since human colonization of New Zealand and up to 10 Ma to return to today's species numbers if currently threatened species go extinct. This study puts into macroevolutionary perspective the impact of humans in an isolated fauna and reveals how conservation decisions we take today will have repercussions for millions of years.

5. Arthropods in a warming Arctic: new predictors for their advancing phenology

Mikhail Zhemchuzhnikov, Thomas Lameris, Job ten Horn, Jan van Gils
Royal Netherlands Institute for Sea Research

Arthropods are an essential component of Arctic ecosystems, contributing to soil formation, pollinating flowers, and being the key prey for insectivorous migratory birds during their breeding season. Thus, synchronization between phenology of arthropods and phenology of other ecological groups ensures the stability of the biome. However, the globe is getting warmer and the Arctic is warming faster than the rest of the world. It often results in phenological mismatches because different trophic levels respond to temperature change with different rate. Hence, it is vital to predict arthropod phenology reliably to estimate mismatches better. Besides direct measurements of abundance, there are many ways for predicting arthropod phenology. For example, by using environmental indicators, such as snowmelt, or climatic variables, such as growing degree days, which is the cumulative temperature above certain a threshold (usually 0 ºC). These predictive models work better for species with a pronounced abundance peak, which is not always the case for the Arctic. It may also be that cumulative soil temperature is a better predictor of phenology for soil dwelling arthropods. Here we compare models based on cumulative air temperature, cumulative soil temperature, and snowmelt in order to find out which model predicts arthropod phenology most accurately.

6. Mitigating and adaptive strategies for eutrophication management towards a sustainable Anthropocene

Mangi Chang, Dianneke van Wijk, Lilith Kramer, Annette Janssen, Wolf Mooij, Sven Teurlincx
Netherlands Institute of Ecology / Wageningen University & Research

Eutrophication is a hallmark of the Anthropocene. As a consequence of nutrient release by human activities (i.e. agriculture, industry and domestic sewage), worldwide aquatic ecosystems have changed from vegetation-dominant systems that were prevalent in the Holocene to phytoplankton-dominant systems. This change in ecosystem assemblage and functioning threatens the Safe Operating Space of humanity, and calls for sustainable solutions that meets the economic, environmental and social demands and constraints of contemporary human societies. This implies we need to find a balance between the rate of nutrient release and the rate at which nutrients are processed by nature. We therefore developed a Resource-Producer-Consumer-Waste model. This model captures the dynamics of resource consumption and waste accumulation in mitigating and adaptive strategies towards a sustainable Anthropocene. For the mitigation strategy, we developed a semi-mechanistic model (GPLake) to give a first estimate of the required nutrient reduction for water quality improvement in lakes worldwide. For the adaptive strategy, we propose Smart Nutrient Retention Networks that employ the synergistic interaction between nutrient retention and improved water quality at the catchment level. These models can be used to develop feasible scenarios for dealing with eutrophication and thereby move us away from dystopian futures towards a sustainable Anthropocene.

1c: Nitrogen in Ecosystems

Conveners: Rik Veldhuis (University of Groningen)
Fons Smolders (Radboud University)

1. **The impacts of atmospheric nitrogen deposition on natural and semi-natural ecosystems: an overview.**
Roland Bobbink
B-WARE Research Centre

Atmospheric nitrogen deposition, from both oxidised (NOy) and reduced (NHx) compounds, is nowadays one of the main threats for biodiversity. The severity of its impacts depends on the biogeochemistry of the particular ecosystem. Long-term nitrogen enrichment may gradually increases the soil nitrogen availability of nitrogen leading to competitive exclusion of characteristic species by more nitrophilic plants. Soil acidification, with losses of base cations and increased concentrations of toxic metal (Al), is especially important in weakly buffered environments when acid-resistant plant species became dominant while many endangered plants disappear. The observed change in the balance between reduced and oxidised nitrogen may also affect the performance of several characteristic plants. The susceptibility of plant species to secondary stress factors can be impacted, too. This complex of changes also negatively influence the diversity of animals in the food web. Anthropogenic N inputs are changing plant and animal communities to a significant extent, with an overall effect of biodiversity loss. Spontaneous recovery of soils and vegetation after reducing N deposition appears to be very slow. Hence, active restoration is essential to preserve biodiversity under long-term excessive N. Besides, a significant reduction of N deposition is highly needed in the near future.

2. **Mitigating the effects of N deposition in dry heathlands**
Maaike Weijters, Roland Bobbink, Joost Vogels
B-WARE Research Centre

The effects of N-deposition on the Dutch heathlands on sandy soils are severe. What are the restoration options? Are all measures effective? Do we have new tools in our restoration toolbox? In this presentation we will reflect on restoration measures that were and are widely used (sod-cutting, liming), and give insight in the possibilities and uncertainties of rock powder as "new" restoration tool.

3. **Linking nitrogen deposition, producer quality and fauna: what do we know, what can we expect?**
Joost Vogels, Dedmer van de Waal, Marijn Nijssen, Arnold van den Burg, Maaike Weijters, Michiel Wallis de Vries
Bargerveen foundation / Radboud University

Global rates of N deposition have increased strongly since around 1950 and are expected to further increase by future precipitation scenarios, having major implications for ecosystem functioning. For primary producers mechanisms affected by nitrogen deposition are largely known, ultimately affecting species richness and biodiversity. Monitoring data of consumers indicate that these organisms are also affected by N deposition. Operational mechanisms are hardly understood and especially those linking consumer performance to altered producer nutritional quality remain largely unexplored. Therefore, we conducted a literature study aimed at unraveling producer-consumer interactions, known or expected to be affected by N deposition. Articles providing mechanistic insights from the fields of ecological stoichiometry, nutritional geometry, ionomics and metabolomics were used in this review study. Literature derived hypotheses for further study are presented and partly tested using results from recent experimental and correlative studies.

4. **The effects of abiotic measures and fungi on regeneration of *Juniperus communis***
Rik Veldhuis, Chris Smit, Fons Smolders, Kris Verheyen
University of Groningen

Populations of common juniper (*Juniperus communis*) are declining in western Europe because of a lack of regeneration. The lack of regeneration is associated with the degree of nitrogen deposition which causes soil acidification and nutrient leaching. These can directly affect junipers or indirectly by affecting their interaction with mycorrhizal fungi. Mycorrhizal fungi can improve e.g. nutrient uptake and drought tolerance of plants which can be crucial on nutrient poor sandy areas where junipers occur. Soil acidification can harm mycorrhizal fungi thereby reduce their positive effects on plants. In this study we investigated measures that can mitigate the detrimental effects of acidification on juniper seeds and cuttings. In a field experiment, we examined the effects 3 abiotic treatments (control, addition of lime and addition of rock powder) and 3 biotic treatments (control, addition of mycorrhizal fungi, addition of fungicide) on survival and growth of juniper cuttings.

5. Interactive effects of warming and eutrophication on methane cycling communities in shallow lakes

Thomas Nijman, Thomas Davidson, Stefan Weideveld, Joachim Audet, Annelies Veraart
Radboud University

Two of the main issues that are changing shallow lakes are climate warming, and eutrophication by nitrogen and phosphorus pollution. Both these issues affect the dynamics of lakes, also in the sediment, which harbour a highly active methane cycling community. However, the interactive effect of climate warming and eutrophication on the methane cycling community remains to be elucidated. In this project, we sampled 24 mesocosms with 2 nutrient regimes (fertilized, not fertilized) and 3 temperature treatments (ambient, +~4°C, +~6°C). We determined in situ CH4 emissions, potential CH4 oxidation and production rates, and abundance of methanotroph and methanogen marker genes using qPCR. We found that potential CH4 oxidation was not affected by temperature but was nearly doubled in fertilized mesocosms. Potential CH4 production tended to increase with temperature at low nutrient concentrations, and more than doubled when fertilized. Higher DNA amounts in sediment from fertilized mesocosm indicate a likely higher bacterial abundance, but qPCR analysis will give a proxy of methanotroph and methanogen abundance. Our results show that increases in nitrogen and phosphorus load will increase activity of the methane cycling community, and give further insight into the mechanisms that drive CH4 production and oxidation in lake sediments.

6. Resilience to high N deposition in Grey dunes (H2130): interactions between pH, P nutrition, plant mycorrhizal strategies and soil community composition

Annemieke Kooijman, Elly Morriën, Jaap Bloem
University of Amsterdam

Calcareous and acidic dunes differ in resilience to high atmospheric N deposition, due to differences in P availability and plant strategies, or differences in soil communities and N cycling. In calcareous dunes with low grass-encroachment, P availability was low despite high amounts of inorganic P, due to low solubility of calcium phosphates and strong P sorption to Fe oxides at high pH. Calcareous dunes were dominated by low-competitive arbuscular mycorrhizal (AM) plants, which profit from mycorrhiza especially at low P. In acidic dunes with high grass-encroachment, P availability increased as calcium phosphates dissolved and P sorption weakened with the shift to Fe-OM complexes. Also, part of the sorbed P was organic. Acidic dunes were dominated by nonmycorrhizal (NM) plants, which increase P uptake through exudation of carboxylates and phosphatase enzymes, which release weakly sorbed P, and disintegrate labile organic P. The shift in plant strategies changed the soil community. In calcareous dunes, fungal feeders increased due to the presence of AM fungi. In acidic dunes, the bacterial pathway increased due to exudation of small organic molecules by NM plants. This reduced differences in N cycling, and showed that pH, P and plant strategies are major factors to counteract N deposition.

1d: Marine Benthic Ecology

Conveners: Anna de Kluijver (Utrecht University)
Tanja Stratmann (Utrecht University / Pax Planck Institute for Marine Microbiology)
Martijn Bart (University of Amsterdam)

1. **Gold rush in the deep sea: Environmental impacts of polymetallic nodule extraction**
Tanja Stratmann, David Amptmeijer, Daniel Kersken, Ilja Voorsmit, Andrey Gebruk, Alastair Brown, Autun Purser, Yann Marcon, Andrew Sweetman, Daniel Jones, Lisa Mevenkamp, Ann Vanreusel, Clara Rodrigues, Ascensão Ravara, Marina Cunha, Erik Simon-Lledó, Kevin Köser, Karline Soetaert, Dick van Oevelen
Utrecht University / Max Planck Institute for marine microbiology

Land-based mines for metals such as cobalt, nickel or copper are either located in politically instable countries or are more and more depleted. Therefore, mining of deep-sea minerals, such as polymetallic nodules, cobalt-rich crusts, and massive sulphide deposits, has been considered as an alternative. However, the extraction of these minerals will have severe consequences for the ecosystem. To assess whether the ecosystem will recover from industrial-scale deep-sea mining, we studied a small-scale benthic disturbance experiment in the abyssal plains of the Peru Basin (SE Pacific), the so called 'DISCOL' experiment. During this experiment in 1989, a 10.8 km2 large circle of seafloor was ploughed with a plough harrow to mimic the extraction of polymetallic nodules and the potential ecosystem recovery was investigated during five follow-up studies until 2015. In this talk I explain how I used binary food-web models of two abyssal plains in the Pacific, the analysis of deep-sea still images, in situ pulse-chase experiments with stable isotopes, and carbon-based food-web models to investigate which parts of the benthic ecosystem have recovered 26 years after the 'DISCOL' experiment, which have not, and which will not recover for millions of years.

2. **Deep sea sponge grounds as biogeochemical hotspots**
Martijn Bart, Anna de Kluijver, Benjamin Mueller, Ulrike Hanz, Furu Mienis, Teresa Morganti, Ellen Kenchington, Klaas Nierop, Jack Middelburg, Hans Tore Rapp, Jasper de Goeij
University of Amsterdam / Utrecht University

Sponges are ecosystem engineers that mediate energy and matter transfer in deep-sea food webs and that host various microbes involved in biogeochemical cycles. Deep sea sponge grounds in the North-Atlantic Ocean, form complex habitats and host high biodiversity, but information on the functioning of these deep sea sponge grounds is scarce. In this talk we will present results of the EU sponGES project, where we study ecology and biogeochemistry of North-Atlantic boreal and Arctic sponge grounds, found at depths ranging from 200-1000 m. We studied how deep-sea sponges take-up nutrients from sub-cellular (>50nm; visualized using NanoSIMS) to ecosystem (>100km2) scale, using a combination of ex situ and in situ incubation with stable isotope and fatty acid analyses. We found that although deep-sea sponges readily consume particulate organic matter, their major food source is dissolved organic matter. Additionally, deep-sea sponges efficiently recycle their waste-products in a complex interaction between sponge host and microbial symbionts. These interactions are also reflected in their complex fatty acid profiles. Sponges produce unique fatty acids, which can be used as chemotaxonomic and trophic markers, since some are present in associated fauna. Upscaling of measured fluxes and microbial transformations demonstrate that sponges are biogeochemical hotspots in the deep-sea.

3. **Exploring different sponge engines in coral reefs: Processing of different types of dissolved organic matter (DOM) fuel by high and low microbial abundance sponges**
Sara Campana, Meggie Hudspith, Celine Demey, David Lankes, Benjamin Mueller, Jasper de Goeij
University of Amsterdam

Sponges play a key role in biogeochemical cycles on coral reefs, by recycling dissolved organic matter (DOM) via the sponge loop. Benthic algae and corals release different types and quantities of DOM. Coral-DOM might be mainly incorporated in sponge cells, whereas algal-DOM in associated microbes. Given the coral- to algal-dominance shift on current reefs, we question whether high microbial abundance sponges (HMA) are better at using algal-DOM, profiting over low microbial abundance sponges (LMA). We compared the processing of coral-, macroalgal-, and diatom-DOM by three HMA and three LMA sponges. We determined assimilation and respiration rates of labelled 13C- and 15N-DOM and 13C incorporation by sponge versus microbial cells into specific phospholipid fatty acids (PLFA). All DOM sources were utilized by all investigated species, but LMA sponges took up DOM at significantly higher rates than HMA sponges. All species preferably assimilated diatom-DOM for carbon and macroalgal-DOM for nitrogen. Assimilation of macroalgal-DO15N was 3-fold higher than other sources, indicating its higher bioavailability to the sponge holobiont. HMA species assimilated carbon more efficiently (i.e. lower assimilation: respiration ratio), but LMA sponges assimilated twice the amount of $DO^{13}C$. Results suggest that both the sponge host and its core microbial community drive DOM processing, but the more complex microbiome of HMA may give the holobiont higher metabolic plasticity. Nonetheless, LMA sponges are equally important in carbon cycling on coral reefs. In a future scenario where algal DOM is expected to increase, sponges are likely to benefit from it, especially for their nitrogen metabolism.

4. Unravelling foreshore ecosystem dynamics: applications for ecosystem-based coastal defense

Beatriz Marin-Diaz, Laura Govers, Daphne van der Wal, Eduardo Infantes, Han Olff, Tjeerd Bouma
Royal Netherlands Institute for Sea Research

The combination of foreshore ecosystems and conventional barriers (e.g. dikes) can provide a more sustainable and cost-effective alternative for flood protection. However, the use of natural ecosystems needs to be further studied to test their reliability on the long term and in face of climate change. We aimed to unravel uncertainties about foreshore soil stability to provide new insights in the management of foreshore ecosystems for coastal protection. We experimentally assessed how soil stability of seagrass, tidal flat and salt marsh sediments contributes to coastal protection and how management regimes may contribute to this. We found that eelgrass can reduce horizontal transport of sediment by the roots and rhizome network, although saltmarshes have a greater effect on soil stabilization both laterally and horizontally. Grain size, root density and soil structure were key parameters. Surprisingly, grazing by small herbivores indirectly reduced soil erodibility in the low marsh through a change in plant community and soil structure. Large herbivores reduced erodibility in the marshes through trampling, although they also reduced soil elevation. Overall we conclude that saltmarshes are valuable ecosystems to implement as ecosystem-based coastal protection.

5. Scale-dependent functional patterns in the marine benthos

Olivier Beauchard
Royal Netherlands Institute for Sea Research

The benthology of Dutch marine waters has a long history, and after more than twenty years of regular monitoring, the distributions of the most characteristic benthic macroinvertebrate species are well documented. However, the understanding of these species assemblages in their specific environmental conditions remains largely unexplored. Basically, species biological attributes are evolutionary determinants of habitat occupancy, and therefore, combining species distributions with species biology is of crucial necessity to the understanding of species assembly rules. On an applied point of view, investigating the biological functioning of species communities enables comprehensive approaches to explain or predict the effects of human activities on natural habitats, and ultimately, mapping habitat vulnerability. In this work, a description of spatial patterns of benthic species communities through the use of biological traits is presented in a multi-scale context. A first outcome is the prominent effect of hydrodynamism at the largest scale, which strongly affects organism life strategies in the trade-off opposing offspring to adult survivals. Secondly, an increased complexity of the relationships between traits and environmental conditions is observed within habitat under high dynamism. Contrasting scale-dependent relationships between traits and environment are shown, with major consequences for management.

6. Wadden Mosaic: Understanding the ecological functioning of the subtidal Wadden Sea

Oscar Franken, Sander Holthuijsen, Quirin Smeele, Han Olff, Tjisse van der Heide, Laura Govers
University of Groningen / Royal Netherlands Institute for Sea Research

The Wadden Sea is of great ecological importance and supports many species of birds and fish. These species depend on a plethora of benthic invertebrate species living in the sediment. While the intertidal mudflats are relatively well studied, the biodiversity and food web structure of the subtidal Wadden Sea is relatively unknown. It is thought that the sea floor once consisted of a diverse mosaic of sand, silt, boulders, mussel beds, shells, seagrass beds, flat oysters and other structures, but there are indicators that this mosaic has become more homogeneous over time. Over the course of the next four years, the Wadden Mosaic project aims to shed light on this hidden part of the Wadden Sea. We will map biodiversity and link the benthic communities to habitat characteristics. In addition, we will test the feasibility and effects of possible management actions by: i) applying hard substrates, ii) (re-)introducing epibenthic shellfish beds, iii) testing restoration possibilities of subtidal seagrass meadows and iv) testing the effectiveness of excluding bottom trawling fisheries from marine protected areas. The results from the project will improve our understanding of the ecological functioning of the subtidal Wadden Sea, and predict the effectiveness of management practices aimed at sustaining or increasing biodiversity.

Parallel Session 2

2a: Movement Ecology

Conveners: Casper van Leeuwen (Netherlands Institute of Ecology)
Allert Bijleveld (Royal Netherlands Institute for Sea Research)

1. Explaining changes in annual cycle movements in response to climate change
Christiaan Both
University of Groningen

As a consequence of climate change, many migrant birds have to advance the arrival at their breeding grounds in order to keep in synchrony with local food peaks. Some species manage to do this, whereas others fail to adjust sufficiently. Basically four different processes exist by which migrants can change their annual cycle to maintain the synchrony: 1. Advancing departure from wintering grounds, 2. Increasing migration speed, 3. Wintering at more northern latitudes, 4. Dispersing to more northern breeding sites with later phenology. In this talk I review some of the evidence for all four of these strategies, and discuss why some species may adjust, whereas other fail.

2. Bill length and sex shapes diet, fuel deposition and migration timing in a long-distance migrant
Thomas Lameris, Jutta Leyrer, Thomas Leerink, Jan van Gils
Royal Netherlands Institute for Sea Research

Global warming is increasingly becoming recognized as a driver of changes in body size, and such physiological changes can have cascading effects throughout the life cycle. This has for example been shown for Red Knots, which are returning to their wintering grounds in West Africa with increasingly shorter bills. This has been shown to impact their local diet and their survival. We hypothesized that the effects of a shorter bill may carry over beyond the wintering grounds, possibly even into an individuals' reproductive success. We used stable isotopes from blood samples and feathers of close to 4000 individual birds to infer their diets and migration timing. We find that birds with shorter bills, as well as males, ate more sea grass (relative to bivalves) during winter in West Africa, and their diet consisted almost exclusively of sea grass in spring. During spring migration, these same birds maintained lower fuel loads. Shorter-billed birds were the first to depart from the Wadden Sea, but this did not affect their timing of reproduction. We conclude that bill length does result in individual differences in diet and fuel deposition, but that these differences do not carry over to affect reproductive success.

3. Barnacle geese rapidly adjust migratory habits to climate change through social learning
Thomas Oudman, Kevin Laland, Graeme Ruxton, Ingunn Tombre, Paul Shimmings, Larry Griffin, Jouke Prop
University of St Andrews

Long-distance migratory animals differ greatly in whether and how they adjust their migratory movements to climate change. Species that socially learn their migration routes may have an advantage by allowing newly discovered strategies to be inherited. However, evidence from the wild that social learning helps migrants adjust to environmental change is scarce. Based on forty years bird counts and individual resightings, we show that a population of barnacle geese (*Branta leucopsis*) have largely shifted to using a new spring-staging site along the Norwegian coast within a period of fifteen years. Annual estimates of local grass production suggest that the shift is a response to improved foraging conditions at the new staging site but not at the traditional site. To explain how the geese were able to respond so quickly, we compared a set of individual-based models to the empirical data. The best performing models were those in which the individuals travelled in groups led by the oldest birds, with higher rates of group switching among younger birds. This shows that details in the decision-making process can be essential to understand how migratory animals respond to changing environments.

4. Collective spatial segregation between non territorial central-place foragers

Geert Aarts, Louise Riotte-Lambert, Evert Mul, John Fieberg, Sophie Brasseur, Jan van Gils, Jason Matthiopoulos
Royal Netherlands Institute for Sea Research

Resource competition among central place foragers often leads to space partitioning, even if species do not show signs of direct agonistic interactions. Using individual-based simulations, we show that spatial knowledge and memory of resource availability are sufficient to give rise to collective spatial segregation of colonial central-place foragers. The shapes of the foraging distributions are governed by travel costs (between the colony and a foraging site), the emerging distribution of depleted resources, and the fidelity of foragers to the central-place. Regional asymmetry between the density of animals and resources, can lead to complex space-use patterns propagating through the landscape. Interestingly, while higher quality spatial memory lowers the overlap between colonies, it could lower the overall foraging efficiency of the population as a whole. This suggests that spatial segregation might be adaptive at the individual level, but may lead to sub-optimal foraging distributions at the population level.

5. Spatiotemporal variation in disturbance impacts derived from combined tracking of aircraft and shorebirds

Henk-Jan van der Kolk, Andrew Allen, Bruno Ens, Kees Oosterbeek, Eelke Jongejans, Martijn van de Pol
Netherlands Institute of Ecology

Combined tracking of animals and disturbance sources is a potential tool to assess disturbance impacts over large spatiotemporal scales. We tracked 90 Eurasian oystercatchers *Haematopus ostralegus* and all aircraft in a military training area in the Dutch Wadden Sea. We first quantified dose-response curves of disturbance by five types of aircraft by estimating flight probability and displacement distance, by comparing bird displacement prior to aircraft presence with displacement during aircraft presence. Then, we used those dose-response curves to map mean and variation in additional daily energy expenditure due to aircraft disturbance across the landscape for a 700-day period. Flight probability and displacement responses differed strongly among aircraft types and decreased from transport aircraft, bombing exercises, helicopters, jets to small civil aircraft. Since the most disturbing aircraft were also most rare, estimated mean additional daily energy expenditure was low and unlikely to affect survival. Disturbance costs, however, spiked on days with transport aircraft. Mitigation of disturbance impact should mainly focus on reducing the few highly disturbing activities. Our approach can be applied to other species and disturbance sources that are automatically tracked, such as boats and walkers. The resulting disturbance impact maps can be used to model mortality impacts of disturbance.

6. Observing and modeling regional migratory patterns of birds using meteorological radar

Bart Kranstauber, Willem Bouten, Judy Shamoun-Baranes
University of Amsterdam

Quantitative information about the spatio-temporal distribution of migratory birds can be important for conservation efforts and reduce human-wildlife conflicts. Of the variety of methods used to study migration, few are suitable to provide insight into spatio-temporal changes in abundance of migrants, especially small species across broader spatial regions. Meteorological radar can solve this knowledge gap. Here we show how spatial information about bird migration can be extracted from meteorological radar and integrated across a radar network. We developed and implemented a method to correct for bird detection biases to extract additional information about spatial variation in bird densities at fine to regional scales. We provide a few examples of how visualizations can reveal fine scale heterogeneity in migration movements. Information on migration densities was then used to develop a predictive model for bird migration using a range of weather parameters as predictors of migration intensity. The predictive model is developed to reduce collisions between birds and military aircraft and could also be applicable for reducing collisions between birds and wind turbines.

2b: TRENDS in Microbiome Research

Conveners: Ben Oyserman (Netherlands Institute of Ecology)
Viviane Cordovez (Leiden University)

1. Linking host genotype and microbiome

Ben Oyserman, Viviane Cordovez
Netherlands Institute of Ecology

Microbial interactions with hosts contribute both directly and indirectly to host health and fitness. Of particular interest are interactions that result in the emergence of beneficial phenotypes such as disease suppression, improved nutrient acquisition, or drought tolerance. Engineering natural and agricultural systems to exploit these emergent **m**icrobiome **a**ssociated **p**henotypes (MAPs) is expected to transform the agricultural industry and lead to more sustainable food production, and benefit restoration and conservation efforts. For example, pesticide use may be reduced by breeding crops that take advantage of beneficial biological interactions. To achieve this, numerous bottlenecks must be addressed. First, a key challenge will be to develop a quantitative and systematic platform for identifying and prioritizing MAPs. Once prioritized, the second challenge is to unravel the molecular mechanisms for both host and microbe. Due to the complexity of confounding ecological interactions, developing an appropriate model to test the importance or particular interactions is essential to develop ecologically robust MAPs. In this presentation, I will briefly present the theoretical framework we have developed to tackle these bottlenecks.

2. Combined effects of light and nutrient availability on freshwater macrophyte quality and its associated microbial biofilm

Mandy Velthuis, Hans-Peter Grossart, Annelies Veraart, Luca Zoccarato, Piet Verdonschot, Sabine Hilt
Leibniz-Institute of Freshwater Ecology and Inland Fisheries

Plant-associated biofilms are commonly known as important components of freshwater ecosystems. Their microbial diversity and community composition, however, is highly variable, depending both on abiotic conditions and on the abundance and organic matter quality of the host plant. Here, we tested the effects of light and nutrient availability on the C:N:P stoichiometry and phenolic contents of the submerged macrophyte *Elodea nuttallii* and the associated bacterial and fungal community in its biofilm. The plants were grown in mesocosms for 8 weeks under low and high sediment nutrient conditions. To manipulate light availability, half of the mesocosms were shaded. Shading led to significantly reduced C:N ratios of *E. nuttallii*, while phenolic content increased simultaneously. The microbial community composition was determined at the end of the experimental period by Illumina Amplicon sequencing of the bacterial 16S rRNA and fungal ITS genes. The sequencing revealed dominance of the bacterial orders Burkholderiales and Methylophilales, while the fungal orders of Agaricales and Xylariales dominated. The community composition of both bacteria and fungi was significantly different between the light treatments, while nutrient treatment only affected the bacterial composition. During the conference, these shifts in microbial community composition will be linked to the environmental conditions in the experiment.

3. Wheat rhizosphere bacterial communities and protection against soil-borne pathogen

Lilian S. Abreu S. Costa, Mirian R. Faria, Josiane B. Chiaramonte, Wagner Bettioll, Rodrigo Mendes, Jos Raaijmarkers.
Embrapa Environment

During the fungal invasion, a number of specifics bacterial families and functions are enriched in the rhizosphere to fend off plant infection. Thus, considering that the host plant relies on the rhizosphere microbiome for protection, we promote the enrichment of the rhizosphere microbiome in contrasting materials for tolerance against the soil-borne pathogen *Bipolaris sorokiniana*. The disease evaluation and rhizosphere soil collection were repeated in a total of 5 cycles, in microcosm pot. Rhizosphere community structure was assessed through 16S rRNA amplicon sequencing. The soils of tolerant genotype showed a high level of disease over cycles, on the other hand, the soil of susceptible genotypes presented a low level of disease, suggesting an ability to disease suppression after successive growth cycles. In general, those treatments without pathogen showed an increase of disease level over cycles. The results showed a cycle effect revealing a shift in microbial communities over cycles, and more homogenous pattern in cycles 4 and 5. The constrained analysis showed genotype effect revealing a clustered separately between tolerant genotype and susceptible. The results indicated that disease dynamics can be driver by the host traits that recruit an antagonistic community with the ability to protect the root system.

4. Can we find clues in the fecal microbiome of laying chickens that we can relate to exposure to wild birds and their potential pathogens?

J. Schreuder, F.C. Velkers, R.J. Bouwstra, N. Beerens, J.A. Stegeman, W.F. de Boer, A.R.W. Elbers, P. van Hooft, S.D. Jurburg
Utrecht University

Laying chickens with access to outdoor ranges are exposed to environmental micro-organisms, including potential pathogens excreted with wild bird feces. Interspecies transmission of fecal microbiota may therefore serve as a proxy for contact between domestic and wild animals to assess risks for disease transmission. Alterations in the chickens' fecal microbiome community parameters or relative abundance of individual genera, determined by 16S rRNA sequencing, might hold clues related to the risk of exposure. To assess whether this could be a useful approach to identify layer farms at high risk of exposure, a proof-of-principle experiment was done where layers were inoculated with wild duck feces. Furthermore, in a cross-sectional study in commercial layer farms we evaluated differences in fecal microbiomes of outdoor-housed vs indoor-housed layers. Results showed that the chickens' microbiome was to a limited extend affected by duck feces inoculation. The microbial composition of adult layers under field conditions was mainly affected by the poultry house and farm, and the rearing flock in which the layers were raised previously, and only minimally by access to an outdoor range. Overall, measuring differences in fecal microbiota of layers as a proxy for the level of exposure to potential pathogens and biosecurity seems infeasible.

5. Seasonal variation in the gut microbiome of homing pigeons

Maurine W. Dietz, Kevin Matson, Maaike A. Versteegh, B. Irene Tieleman
University of Groningen

Gut bacteria modulate digestion, immune function, and behaviour in hosts. Some host-related traits also influence their gut bacterial communities (gut microbiome, GM). Diet can drive interspecific and intraspecific GM variation, including seasonal variation. Furthermore, seasonal GM variation can relate to intrinsic host changes, e.g., seasonal weather adaptations, including those associated with endogenously regulated annual cycle stages like reproduction. We investigated the impact of intrinsic host variation on seasonal GM variation by repeatedly sampling pigeons (*Columbia livia*) in two summers and two winters. Same-sex groups of pigeons were housed in outdoor aviaries. Offered food composition was constant; temperature and daylength varied naturally. Between-season differences in GM richness and phylogenetic diversity depended on sex. Richness was higher in winter in females but not in males; phylogenetic diversity was lower in winter in males but not in females. Bray-Curtis distances and the two most abundant phyla also varied by season and sex. Firmicutes was more abundant in winter; Actinobacteria was less abundant in winter. Both taxa had higher relative abundances in males. Intrinsic host variation thus shapes seasonal GM variation in pigeons. As opportunistic breeders, pigeons maintain relatively stable year-round reproductive condition; hence, adaptations to seasonal weather variation likely shaped their GM variation.

6. Speeding-up nature restoration with soil microbiome steering: a case study of bottom-up and top-down regulation of microbial communities

Elly Morriën, S.E. Hannula, J. Doyle, L.B. Snoek, G.F. Veen
University of Amsterdam

Restoring natural plant communities on abandoned agricultural fields can be challenging due to a degraded soil community and a fertilizer legacy. We discovered that fungi are the initiators of a tighter connected soil food web which restores the closed carbon and nutrients cycles in soils, thereby accommodating species-rich plant communities in grasslands. Boosting the fungal channel as a bottom-up approach could thus be used as a next-generation restoration measure. We show data of soil inoculation experiments and trace the progression of change in the fungal community via sequencing and functioning via community response profiles. We assessed the top-down foraging of predators and consumers on the microbiome by analysing gut contents of consumers and predators from different restoration stages. Additionally, we pioneered with plant exudate manipulations on the changes in fungal communities in these grasslands. We will be able to show preliminary data on the effect of fungi and their higher trophic levels in stimulating species-rich plant communities as well as give a prospect on the wider applications for microbiome engineering.

2c: Ecology and Conservation

Conveners: Ignas Heitkönig (Wageningen University and Research)
Rascha Nuijten (Netherlands Institute of Ecology)

1. **Conservation attention necessary across at least 44% of Earth's terrestrial area to safeguard biodiversity**
James Allan, Hugh Possingham, Scott Atkinson, Anthony Waldron, Moreno Di Marco, Vanessa Adams, Stuart Butchart, Oscar Venter, Martine Maron, Brooke Williams, Kendall Jones, Piero Visconti, Brendan Wintle, April Reside, James Watson
University of Amsterdam

More ambitious conservation efforts are needed to stop the global degradation of ecosystems and the extinction of the species that comprise them. Here, we estimate the minimum amount of land needed to secure known important sites for biodiversity, Earth's remaining wilderness, and the optimal locations for adequate representation of terrestrial species distributions and ecoregions. We discover that at least 64 million km^2 (43.6% of Earth's terrestrial area) requires conservation attention either through site-scale interventions (e.g. protected areas) or landscape-scale responses (e.g. land-use policies). Spatially explicit land-use scenarios show that 1.2 million km^2 of land requiring conservation attention is projected to be lost to intensive human land-use by 2030 and therefore requires immediate protection. Nations, local communities and industry are urged to implement the actions necessary to safeguard the land areas critical for conserving biodiversity.

2. **The afterlife of wood (through SKYPE)**
Shanshan Yang, Lourens Poorter, Frank Sterck, Ute Sass-Klaassen
Forest Ecology & Management Group, Wageningen University

Deadwood not only plays an important role in carbon storage, but also in forest biodiversity by providing habitats, shelter and food source to forest dwelling species: Dutch forests contain only around 40 shrubs and tree species, but as much as 1250 species of wood-inhabiting fungi. However, for centuries, deadwood had been considered to be a threat to forest by bringing disease, and been removed constantly, which was the key reason for biodiversity loss in Europe. Recently, the crucial role of deadwood for biodiversity has been recognized, but most emphasis is about "quantity" rather than "quality" of deadwood. Here I use a common garden experiment with deadwood of 16 tree species to evaluate: how tree species differ in functional traits and how they give rise to different fungal communities? I found tree species mainly differed along two axes of trait variation: 1) species with higher permeability (e.g. larger conduit size) to species with stronger physical defense (e.g. higher lignin content); 2) species with stronger chemical defense (e.g. higher anti-fungi phenolics) to species with higher PH. A diversity in deadwood tree species and wood functional traits can therefore contribute to a higher fungal diversity.

3. **Averting a salamander crisis: understanding the mechanisms driving population persistence and disease spread**
Jesse Erens, Kathleen Preißler, Wouter Beukema, Jeroen Speybroeck, Gwij Stegen, Annemarieke Spitzen-van der Sluijs, Tariq Stark, Koen Steenhoudt, Sebastian Steinfartz, Frank Pasmans, An Martel
Ghent University

The mass extinction of amphibians presents a major crisis for worldwide biodiversity conservation. Although a multitude of environmental factors lies at the basis of amphibian declines, pathogens pose an increasing threat. A newly emerged pathogen, *Batrachochytrium salamandrivorans* (Bsal), imperils global salamander diversity after invading European salamander populations and causing mass mortality events. We highlight two studies that were instigated to understand the imminent expansion of Bsal and its effect on salamander populations to aid in effective amphibian conservation planning. Firstly, we monitored European fire salamander populations after pathogen detection to assess the mechanisms underlying population persistence. We found that populations survive over prolonged periods, but show a marked demographic shift with increased adult mortality. Molecular analyses were performed to study long-term effects on genetic diversity and potential increased resistance. As such, understanding the adaptability of populations might allow us to better anticipate the long-term effects on salamander species affected by disease-driven declines. Secondly, we identified environmental determinants (natural and anthropogenic) that drive the distribution of Bsal across the landscape and predict its future spread. Besides providing fundamental insights in disease and landscape ecology, application of these findings might direct early-warning monitoring efforts to allow a timely implementation of conservation action.

4. **The impact of protected areas and derogation shooting on the foraging behaviour of barnacle geese in Friesland, Netherlands: a modelling study**
Monique de Jager, Nelleke Buitendijk, Hans Baveco, Bart Nolet
Netherlands Institute of Ecology

With the currently increasing number of overwintering barnacle geese in the Netherlands, the amount of conflicts with farmers seems to rise. Yet, it remains undetermined how goose numbers relate to the amount of crop damage. Also, the effects of derogation shooting and the existence of protected areas on the number of geese foraging on farmland is unknown. Here, we present an individual-based model of barnacle geese foraging on grasslands in Friesland, the Netherlands. With this model, which is parameterized with field observations and GPS tracks, we examine how the foraging behaviour of geese may be altered by different management regimes and how this behavioural change in turn affects the numbers and duration of geese foraging on agricultural grasslands. Furthermore, we can use the model to study the consequences of further increasing goose population size on the amount of crop damage and on the kind of management required to control damage. The results of this study will be of great importance for making informed management decisions considering the establishment of protected areas and derogation shooting of Barnacle geese in the Netherlands.

5. **Contrasting microclimates among hedgerows and woodlands across temperate Europe**
Thomas Vanneste, Sanne Govaert, Fabien Spicher, Jörg Brunet, Sara Cousins, Guillaume Decocq, Martin Diekmann, Bente Graae, Per-Ola Hedwall, Rozália Kapás, Jonathan Lenoir, Jaan Liira, Sigrid Lindmo, Kathrin Litza, Tobias Naaf, Anna Orczewska, Jan Plue, Monika Wulf, Kris Verheyen, Pieter De Frenne
Ghent University

To date, there is a lack of empirical studies quantifying the microclimate of hedgerows, particularly at broad geographical scales. Here we monitored sub-canopy temperatures using 168 miniature temperature sensors distributed along woodland-hedgerow transects, and spanning a 1600-km macroclimatic gradient across Europe. We assessed the variation in thermal buffering along the woodland-hedgerow transects, and linked the observed patterns to macroclimate temperatures as well as canopy structure, overstorey composition and hedgerow characteristics. Our results show that hedgerows are less efficient thermal insulators than woodlands, especially at high ambient temperatures. Particularly during summer, canopy cover, tree height and hedgerow width had strong cooling effects on maximum mid-day temperatures in hedgerows. We believe that this is the first study to quantify hedgerow microclimates along a continental-scale environmental gradient. This knowledge will result in better predictions of species distribution across fragmented landscapes, and will help to elaborate efficient strategies for biodiversity conservation and landscape planning.

6. **What can we learn from the Chinese dryland restoration projects?**
Yanning Qiu, Chi Xu, Zhiwei Xu, Milena Holmgren
Wageningen University & Research

Drylands cover about 40% of the planet, host one third of the world population and are one of the most susceptible ecosystems to environmental degradation. How to effectively restore drylands is a main concern for scientists, policy-makers and communities worldwide. Chinese drylands offer one of the most impressive examples of vegetation collapse followed by large-scale restoration projects. We used a combination of remote sensing and field surveys to assess vegetation changes in a series of restoration programs conducted in the three largest dryland systems of China. We found significant increases in vegetation cover and diversity in restored sites. Using vegetation spatial patterns, we derived several early warning indicators that successfully forecasted the transition process from bare to vegetated lands. These landscape-scale projects demonstrate that active restoration of drylands can successfully contribute to recover important ecosystem functions.

2d: Fungal interactions in a changing world

Conveners: Simone Weidner (Netherlands Institute of Ecology)
Adam Ossowicki (Netherlands Institute of Ecology)
Jan Dirk van Elsas (University of Groningen)

1. **Computational and experimental approaches to determine bacteriophage host-range**
   Bas Dutilh
   Utrecht University

The host range of a bacteriophage is the taxonomic diversity of hosts it can successfully infect. Host range, one of the central traits of any virus, is determined by a range of molecular interactions between virus and host throughout the infection cycle. While the high host specificity observed in many model bacteriophages may reflect isolation bias, new isolation-free approaches for measuring host range suggest that in nature, bacteriophages have host ranges from narrow through broad. Understanding the mechanisms that enable bacteriophages to infect multiple hosts is of considerable importance to understanding bacteriophage ecology and the various clinical, industrial, and biotechnological applications of bacteriophages.

2. **Warming advances virus population dynamics in a temperate freshwater plankton community**
   Thijs Frenken, Corina Brussaard, Mandy Velthuis, Ralf Aben, Garabet Kazanjian, Sabine Hilt, Sarian Kosten, Edwin Peeters, Lisette de Senerpont Domis, Susanne Stephan, Ellen Van Donk, Dedmer van de Waal
   Netherlands Institute of Ecology

Viruses play an important role in aquatic biogeochemical cycles via the so-called viral shunt. Since viruses are obligatory parasites, their production completely depends on growth and metabolism of hosts. Climate-driven shifts in host performance thus may also affect viral infections. Here, we investigated the impact of warming (+4 °C) on virus dynamics in a natural freshwater plankton community over a 5-month period in a mesocosm experiment. We monitored dynamics of viruses and their potential hosts, including heterotrophic bacteria and phytoplankton. Our findings show that warming significantly advanced the early summer peak of the virus community by 24 days, but did not affect viral peak height or the time-integrated number of viruses present during the investigated period. Our results demonstrate for the first time that warming advances the timing of a virus community. Although warming may not necessarily result in a stronger viral control of natural bacterioplankton communities, it can alter host population dynamics, and thus the timing of carbon and nutrient recycling.

3. **The dynamics and diversity of the mycosphere virome**
   Akbar Adjie Pratama, Xiu Jia, Juliana Eschholz, Jan Dirk van Elsas
   University of Groningen

Viruses are abundant entities in most biomes on Earth and their role in ecosystem processes is essential. However, the viruses in soil ecosystems have been overlooked due to the challenging sampling and cultivation approaches. The current next-generation sequencing techniques have revolutionized the study of environmental viruses. Here, I hypothesize that soils contain high viral diversities, especially the mycosphere. The ecological role of viruses for mycosphere bacterial communities is, however, underexplored. In this study, I found that the mycospheres of two fungi, i.e. *Russula ochroleuca* and *R. emetica*, contain as-yet-undescribed viral communities. Most viruses found were predicted to infect Proteobacteria, including Paraburkholderia and Burkholderia spp. The analysis of the genomes of selected viruses showed that phages related to φ 437/VC20 were abundant across two mycospheres. These phages, infecting mycosphere Paraburkholderia spp., were found to contain a gene, amrZ, that may encode a protein involved in modulation of biofilm formation. On another notice, a contig representing another phage, denoted VC14, from bulk soil populations, and predicted to infect Paraburkholderia spp., was found to encompass a gene encoding a phasin; this protein may advance host growth in nutrient-limited environments.

4. Phylogeographic and phylodynamic approaches to explore viral ecology

Simon Dellicour, Sebastian Lequime, Bram Vrancken, Mandev Gill, Paul Bastide, Karthik Gangavarapu, Nate Matteson, Yi Tan, Louis du Plessis, Alexander Fisher, Martha I. Nelson, Marius Gilbert, Marc Suchard, Nathan Grubaugh, Kristian Andersen, Oliver Pybus, Philippe Lemey
KU Leuven

Computational analyses of viral genomes are increasingly being used to unravel their dispersal history and transmission dynamics. Here, we show how to go beyond historical reconstructions and use spatially-explicit phylogeographic and phylodynamic approaches to formally test epidemiological/ecological hypotheses. We focus on the invasion and spread of West Nile virus in North America, responsible for substantial impacts on public, veterinary and wildlife health. WNV isolates have been sampled at various times and locations across North America since its introduction to New York twenty years ago. We exploit this genetic data repository to demonstrate that factors hypothesised to affect viral dispersal and demography can be statistically tested. We find that WNV lineages tend to disperse faster in areas with higher temperatures and we identify temporal variation in temperature as a main predictor of viral genetic diversity through time. Finally, we compare inferred and simulated dispersal histories of lineages in order to assess the impact of migratory bird flyways on the rapid east-to-west continental spread of WNV. Our study demonstrates that the development and application of statistical approaches, coupled with comprehensive pathogen genomic data, can address epidemiological/ecological questions that might otherwise be difficult or unacceptably costly to answer.

5. Here to stay: Usutu virus activity in the Netherlands

Henk van der Jeugd, Reina Sikkema, Bas Oude Munnink, Robert Kohl, Marja Kik, Jolianne Rijks, Chantal Reusken, Ruud Foppen, Marion Koopmans
Netherlands Institute of Ecology

Usutu virus (USUV) is a mosquito-borne flavivirus circulating in Western Europe since 1999. In the Netherlands, USUV was for the first time detected in 2016 during passive surveillance of wild birds. Five months later, in September 2016, it was identified as the likely cause of a major outbreak killing especially blackbirds and captive owls. In a multi-disciplinary study, surveillance for occurrence of the virus and presence of USUV-specific antibodies in wild birds was intensified and dead birds were collected and tissues were screened for the presence of USUV. More than 6000 live birds have been screened so far, and genomic sequences of 112 USUV strains from dead blackbirds were obtained. Further outbreaks of USUV occurred late summer to autumn in 2017 and 2018, but circulation in 2019 was reduced. Passive surveillance showed that at least 10 bird species were infected with USUV, with prevalence being highest in blackbirds (6.2%), song thrush (3.2%) and Eurasian wigeon (3.2%). None of these birds showed clinical signs of disease. The centre of gravity of subsequent outbreaks gradually moved from SE to NW in the Netherlands. USUV-infected birds were found in all months and the virus seems to successfully overwinter in the Netherlands. Two USUV lineages were found to be present without any obvious geographical or temporal pattern. The Africa 3 lineage was most common and continued to circulate year-round, while the Europe 3 lineage occurred less frequent and was probably introduced multiple times from Germany. Blackbird populations in the SE of the country suffered major declines most likely due to USUV-related mortality. How USUV persists in winter in the Netherlands is still unclear and will be the subject of further investigations during the coming years.

6. A new virus of Arabidopsis widespread in geographically dispersed ecotypes

Rene van der Vlugt, A. Verhoeven, R. Augsberger, G. Oymans, J. Damen, Karen Kloth
Wageningen University & Research

A transcriptome study of Illumina HiSeq RNA-seq datasets of different Arabidopsis thaliana ecotypes revealed the presence of virus-like sequences. De novo assembly and subsequent Blastn and Blastx analyses showed high levels of identity of some contigs to RNA1 and RNA2 of several viruses from the genus Comovirus, family Secoviridae. Two RNA sequences were assembled that indeed show the typical genome arrangements of a comovirus including a 3' poly-A tail. The assembled RNA1 sequence consists of 5950 nucleotides (nt), encoding one open reading frame (ORF) of 1850 amino acids (AA). The assembled RNA2 sequence consists of 3600 nt, encoding one ORF of 1046 AA. Both viral RNAs show the highest level of overall nt and AA sequence identity to the comovirus turnip ringspot virus with 58% and 52% for RNA 1 and 58% and 52% for RNA2, respectively. RT-PCR and SYBR-green based detection protocols were developed for both RNA1 and RNA2 of the virus. Tests of seeds batches from various ecotypes from the A. thaliana HAPMAP collection present in Wageningen showed the presence of the virus in different ecotypes. Seeds from several ecotypes, positive for the virus were sown and progeny plants were assessed for possible virus infections and phenotype. Vertical transmission of the virus was confirmed by low virus titres in the F1 plants. Virus-infected plants did not show obvious symptoms and could visually not be distinguished from uninfected plants.

Parallel Session 3

3a: Herbivores and Ecosystems Dynamics

Conveners: Judith Sitters (Vrije Universiteit Brussel)
Ciska Veen (Netherlands Institute of Ecology)

1. Impact of herbivores on alternative stable states of ecosystems

Liesbeth Bakker
Netherlands Institute of Ecology

By their trophic and non-trophic effects, herbivores have strong impacts on landscape structure, community composition and ecosystem functioning. Whereas this is generally acknowledged, still large scale patterns in vegetation distribution are commonly explained by abiotic factors, such as climate or nutrient availability. Whereas undoubtedly, these abiotic factors have important structuring effects on vegetation abundance and ecosystem properties, it remains unclear why herbivores should not be taken into account as ecosystem engineers as well. Particularly, within climate envelopes or a range of nutrient availability, ecosystems can appear in alternative stable states and I hypothesize that here herbivores may be able to induce regime shifts from one state to the other. I illustrate this principle by testing the role of herbivores in inducing a regime shift in underwater landscapes which typically can appear in a clear water state, with abundant vascular aquatic plants, whereas upon eutrophication, the system shifts to a turbid state dominated by algae, without vascular plants. I compare the findings to other ecosystems with well-known regime shifts where herbivores may have similarly large impacts.

2. Anthropogenic fear landscapes influence tree recruitment and tick distribution

Bjorn Mols, Christian Smit, Dries Kuijper, Joris Cromsigt, Evert Lambers
University of Groningen

In the Anthropocene, humans are 'super-predators' whose effects on wildlife may supersede those of natural carnivores. Moreover, fear of humans is increasingly considered as an important factor underlying globally observed changes in animal behaviour, in both predators and ungulates. Yet, there is an ongoing debate on the importance of behaviorally-mediated fear effects of both predators and humans, which emphasises the high need for empirical studies. We investigated how human-induced patterns in deer (*Cervus elaphus* and *Dama dama*) space-use affect tree recruitment and the distribution of an important cervid-associated species: the sheep tick (*Ixodes ricinus*). We measured deer space-use (camera traps), growth and survival of experimentally planted tree saplings, and tick densities (cloth dragging) on fine-scale paired plots close to (20m) and far from (100m) hiking trails, distributed over larger zones with 3 different types of human use: i) no recreation or hunting, ii) recreation only, and iii) recreation and hunting. At fine spatial scales, deer space-use was lower near used hiking trails, but this affected neither tree growth nor survival. In contrast, tick abundance was 2.5-fold lower near used hiking trails and positively correlated with deer space-use. At a large spatial scale, deer space-use was highest in recreation-free zones, which resulted in decreased sapling growth and survival, and higher tick abundance. Neither deer space-use nor sapling growth or survival differed between zones with and without hunting. Our data suggest that deer respond to anthropogenic landscapes of fear and thereby influence tree recruitment and tick abundance. However, the observed patterns in deer space-use did not impact saplings on fine spatial scales, and current hunting activities did not create lasting fear effects, which emphasises that indirect antipredator effects may be more complex than often assumed. This demonstrates how the cascading effects of the fear of humans are pervasive yet context-dependent.

3. The importance of climatic extremes on plant-insect herbivore interactions

Jeff Harvey
Netherlands Institute of Ecology

Anthropogenic climate change is affecting as much as 98% of the biosphere. Biodiversity has already responded to a 1.2 degree of warming since the pre-industrial period, with observed changes in the biology, ecology and distribution of many plant and animal species. One of the greatest threats posed by warming is not changes that humans perceive as slow and incipient, but extreme climatic events (ECEs) that occur over very short timescales and which are embedded in warming that is occurring over much longer timescales (e.g. several centuries). These ECEs include heatwaves, droughts, fire outbreaks and intense rain downpours that have been increasing in frequency, intensity and duration in recent years. Here I report the results of a recent study showing that exposure to one stressor, simulated heavy rain downpours that accompany thunderstorms, can affect the development and survival of micro- and macro-lepidopteran herbivores feeding on the same plant species. The effects on insect performance are not based on changes in plant quality, but on physical displacement caused by rainfall as well as changes in microclimate during rainfall. I argue that an exposure to ECEs associated with ACC may push many insects to their adaptive limit, with significant consequences for ecological communities.

4. **Large herbivores and palms structure soil nutrient cycling in a neotropical frugivore dominated rainforest**
Nacho Villar, Claudia Paz, Valesca Zipparro, Leticia Bulascoschi, Liesbeth Bakker and Mauro Galetti
Universidade Estadual Paulista / Netherlands Institute of Ecology

Many tropical rainforests are dominated by fruit-producing woody species and large frugivore consumers. Yet, the role of such large herbivores in nutrient cycling and subsequent feedbacks on their resources are still unknown. Here we used a long-term exclusion experiment in the hyper-diverse Atlantic Forest of Brazil to examine the impact of large ground-dwelling mammalian herbivores on nitrogen cycling on tropical rainforest soils. Our results suggest a synergistic positive impact of large herbivores and hyper-dominant *Euterpe edulis* palms on nutrient cycling. Furthermore: large herbivores appear to affect the performance of nitrifying bacteria and modulate the landscape-scale variance in nutrient availability. Together these results suggest an important role of herbivores and palms in regulating nutrient cycling in this ecosystem.

5. **Impediments affect deer foraging decisions and sapling performance**
Annelies van Ginkel, Marcin Churski, Dries Kuijper, Christian Smit
University of Groningen

Impediments, such as tree logs, can prevent access to saplings for deer, and can increase perceived predation risk in areas with large carnivores. Therefore, impediments can influence deer foraging decisions and the trade-off between safety and food indirectly influencing tree regeneration. The aim of our study was to test how the presence of an impediment affects deer foraging behavior and tree sapling performance of eight species that differ in preference by deer. We planted saplings without, nearby and inside impediments and followed their faith for three consecutive years in the Białowieża forest, Poland. Deer did not select different tree species without, near or inside the impediment. Due to the overall lower browsing intensity tree saplings increased more in height near the impediment and most inside the impediment. The palatable, and not browse tolerant *Acer platanoides* benefited most from the impediment as this species was heavily browsed without an impediment. In comparison, the presence of an impediment had a smaller effect on the less preferred *Alnus glutinosa, Picea abies* and *Pinus sylvestris* which survived well without an impediment. Our study showed that impediments modified deer behavior as they visited these plots less and thereby indirectly reduced the browsing impact on the preferred tree species.

6. **Zooplankton grazing efficiency is mediated by shelter: an enclosure study on the Marker Wadden**
Hui Jin, Casper van Leeuwen, Liesbeth Bakker
Netherlands Institute of Ecology

Trophic transfer efficiency is an important ecosystem function, which is constrained by the efficiency at which herbivores can consume primary producers. Zooplankton, an important herbivore in the aquatic ecosystem, affects the production of higher trophic levels, such as fish and fish-eating birds, as they are the key linkage between phytoplankton and these higher trophic levels. For shallow lakes, wind-induced turbulence of the water may dampen the efficiency of zooplankton grazing, either directly by decreasing the zooplankton biomass by favoring the small-sized zooplankton, and/or indirectly by decreasing the food quality for zooplankton by increasing the amount of sediment in the water column. We tested whether shelter, aiming at reducing the wind effect, could improve the trophic transfer efficiency between phytoplankton and zooplankton by constructing 12 mesocosm enclosures at the Marker Wadden, an archipelago of five islands newly created in the Markermeer. The results showed that shelter favors trophic transfer efficiency between phytoplankton and zooplankton within the mesocosms by decreasing the concentration of sediment in the water column and increasing zooplankton biomass. In this presentation, I will outline the effects of shelter on the aquatic food web including the interactions among phytoplankton, macrophytes, periphyton, zooplankton and fish.

3b: TRENDS in Eco-Evo Dynamics

Conveners: Aafke Oldenbeuving (Naturalis Biodiversity Center)
Jelle Zandveld (University of Amsterdam)
Joost van den Heuvel (Wageningen University & Research)

1. KEYNOTE: Eco-evolutionary dynamics across scales in a fast-changing world

Martijn Egas
University of Amsterdam

Population dynamics and trait evolution often reciprocally affect each other, complicating the identification of drivers of phenotypic change. Such eco-evolutionary feedback loops are probably widespread because (i) changes in population density depend upon differences in life history trajectories between individuals that are a product of natural selection, and (ii) the outcome and rate of trait evolution can be altered by population density. Evidence of eco-evolutionary dynamics is accumulating at different levels of biological organisation, ranging from populations to communities and even ecosystems. Accurately predicting such short-term change in nature is of prime importance because the world is changing fast into unprecedented conditions. However, few studies have identified the drivers of eco-evolutionary feedback. Here, I will give an overview of the current state of knowledge for eco-evolutionary dynamics across scales of biological organization. To explain how we can make progress in this field, I focus on the dynamics of discrete, alternative phenotypes as study system. If we are to predict the eco-evolutionary population consequences of environmental change accurately, it is necessary that we "complete the paradigm shift" by enriching the theory of eco-evolutionary dynamics with insights from developmental plasticity and demography.

2. Coping with the present while preparing for the future: developmental plasticity in bulb mite weapons

Flor Rhebergen, Isabel Smallegange
University of Amsterdam

Organisms face trade-offs during development, and it depends on environmental circumstances how these trade-offs are navigated. For example, optimizing future reproductive success through development of sexual traits may interfere with optimizing current viability under environmental stress, if both processes compete for time and resources. We use bulb mites (*Rhizoglyphus robini*) to study how such trade-offs can be solved through developmental plasticity. Bulb mite males develop enlarged weaponized legs during metamorphosis. They grow and develop in hostile environments in which food is often scarce, and population density and juvenile mortality are high. Intriguingly, some males do not develop weaponized legs, but normal walking legs. Do weaponless males refrain from developing energetically expensive structures that improve reproductive success in the future, to save viability in the present? We found that male phenotype expression is cued by the resource budget during metamorphosis, immediately prior to maturation. Furthermore, males that refrained from developing weapons matured relatively earlier, thus escaping juvenile mortality quicker, than males that committed to weapon development. Finally, experimentally increased competition for food resulted in an increased proportion of weaponless males. We suggest that developmental plasticity, by facultatively removing the constraints of sexual selection, allows flexible metamorphosis timing in a heterogeneous environment.

3. Long-term community dynamics in bacterial ecosystems

Sijmen Schoustra
Wageningen University & Research / University of Zambia

Microbial ecosystems generally consist of communities with a complex composition. Prolonged propagation in a new environment can change species composition. Various factors, such as initial species composition and pressure from the environment, may influence this change. Trade-offs between species and their roles as individuals towards the overall metabolism within the larger community of different species may be drivers of these changes that can also be interpreted in the context of competitive niche exclusion. Specific research questions include what happens when natural bacterial communities of different origin are brought in a novel, yet similar environment? Will comparable starting communities converge to the same composition, will they remain different or become even more different from each other over time, what factors drive this? I will highlight a specific experiment that we conducted to address these questions. Six comparable but different natural microbial communities from a traditional fermented food were each split into five identical replicates, which underwent 16 repeated propagation cycles in a novel, common environment. We compared bacterial species composition at the start and the end of the experiment. We found that differences in starting community led to significant differences in final community composition during prolonged propagation in the common new environment.

4. Adaptation and adaptive control in periods of environmental change

Tom Van Dooren
Centre National de la Recherche Scientifique / Sorbonne University / Naturalis Biodiversity Center

We handle effects of climate change by means of mitigation and adaptive control. In the biological sciences, adaptations are evolved solutions of engineering problems where organisms need to match an ecological challenge. Adaptation and adaptive control don't need to approach the same outcomes for a population. Based on Adaptive Dynamics theory, a definition is proposed of adapted states and adaptational lags which is applicable during periods with environmental change of any speed and to any character. Adaptation can thus be studied even when it emerges from complex eco-evolutionary processes and targets for adaptation are not defined or known a priori. The approach is exemplified with a model for delayed germination (germination probability) in an annual plant. I discuss how adaptational lags might be estimated from proxies using data collected from natural systems in a reasonably short time frame. An overview is given of ways to incorporate both adaptive control and evolutionary adaptation in models.

5. Functional traits shape liana strategies and niches

Qi Liu, Arne Schreire, Evelien Konings, Frank Sterck, Jiao-Lin Zhang, Lourens Poorter
Wageningen University & Research

Lianas are an important life form in tropical forests, but their ecology is poorly studied. Here we analyses for 29 liana species in a Chinese tropical rainforest how 1) trait associations and trade-offs lead to different plant strategies, and 2) how these traits shape species' water- and nutrient niches. For each species, 18 functional traits were measured related to water and nutrient use, and species niches were quantified using species distribution data in a 20-ha plot. Liana species showed a spectrum in water use, ranging from a water spending strategy (i.e., high water uptake and use) to a water conserving strategy. Unexpectedly, leaf economics traits such as leaf nutrients were not related to this spectrum in water use. Species with a water spending strategy were associated with nutrient-rich soils and species with a water-conserving strategy were associated with nutrient-poor soils. Lianas form therefore a diverse ecological group, and lianas not only partition light gradients, but also soil resource gradients in this seasonally tropical rain forest.

6. Resonance revisited: life-history evolution and food web stability in fluctuating environments

Charlotte de Vries, Franz Simon, Pol Cap de Vila, Elisa Benincà, Rob Salguero-Gómez, Jef Huisman
University of Zürich

Climate change is predicted to increase environmental temporal autocorrelation (i.e. environmental reddening). Environmental reddening increases extinction risk and the probability of critical transitions. Prior work has focused on interactions between single populations and abiotic factors, such as nutrients or light availability. Here, we consider the effect of the timescale of environmental fluctuations on life-history evolution and interspecific interactions. We investigate first how the periodicity of environmental fluctuations impacts life-history trait evolution by calculating changes in the fitness landscape as a function of the period of environmental fluctuations. In line with previous work, we find that highly predictable environmental oscillations shape life-history traits by favoring strategies whose generation time is aligned with the period of environmental oscillation. We investigate the robustness of this resonance effect to increased stochasticity/reduced predictability. Second, we investigate how reddening of environmental noise affects species interactions by adding autocorrelated noise to models of interacting populations. Changes in environmental noise color extend food chain length in a tritrophic model and result in a switch from competitive exclusion to coexistence in a competition model. Our results suggest that environmental reddening can exert selection pressures through its effects on both individual life history and interspecific interactions.

3c: Network analysis in Ecology

Conveners: Pariya Behrouzi (Wageningen University & Research)
Romain Frelat (Wageningen University & Research)
Lia Hemerik (Wageningen University & Research)

1. A biogeochemical network analysis of a common deep-sea sponge

Anna de Kluijver, Dick van Oevelen, Sander Verbiest, Martijn Bart, Sandra Maier, Karline Soetaert, Manuel Maldonado, Jasper M. de Goeij, Jack J. Middelburg
Utrecht University

Sponges are complex and diverse organisms, who live in symbiosis with unique microbial communities and therefore can be viewed as mini-or nested ecosystems. Sponges filter large amounts of water and fuel their host and microbes, who perform key biogeochemical processes, such as (de)nitrification. To address biogeochemistry in sponge holobionts (sponge and associated microbes), we developed a steady-state biogeochemical network model of the sponge holobiont based on a common deep-sea sponge, *Geodia barretti*. The model was constrained with measured flux data (e.g. oxygen and food uptake and nutrient release), stoichiometry data, measured efficiencies and literature data. In this talk I will present the main outcomes of the analysis, but I will also discuss model input, uncertainties, limitations and sensitivity.

2. Carbon processing differs between sandy and silty sites at Bourgneuf Bay

Tanja Stratmann, Willem Stock, Antoine Prins, Cédric Hubas, Bruno Jesus, Tom Moens, Pierre Gernez, Dick van Oevelen, Margarita Bogorad, Koen Sabbe, Karline Soetaert
Utrecht University / Max Planck Institute for Marine Microbiology

Tidal sand- and mudflats play a key role in the functioning of coastal and marine ecosystems. They support coastal fish and shellfish populations and protect coastal areas from sea-level rise and storm surges. To study the role of microphytobenthos in the carbon cycle of these tidal flats, a pulse-chase tracer experiment was conducted at Bourgneuf Bay (France) in summer 2017. At silty and sandy sites, NaH13CO3-solution was sprayed on the sediment surface, and the incorporation of 13C in bacteria, microphytobenthos, extracellular polymeric substances (EPS), metazoan meiofauna, and macrobenthos was followed over time for 24 h (sandy site) to 120 h (silty site). In this talk, I present a carbon-based food-web model that I developed for these silty and the sandy sites to study the carbon flow among sedimentary detritus, dissolved organic carbon, EPS, phytoplankton, microphytobenthos, bacteria, ciliates as part of microbenthos, meiobenthos, and macrobenthos. Both, meiobenthos and macrobenthos compartments resemble the highest taxonomic resolution possible, i.e., species and genus level for nematodes and all macrobenthos, phyla and class for all other meiobenthos taxa. In this way, this food-web model is the largest carbon-based linear inverse food-web model that has been developed so far.

3. Integrating qualitative and quantitative descriptors reveals temporal dynamics of food web

Romain Frelat, Susanne Kortsch, Erik Bonsdorff, Laurene Pecuchet, Pierre Olivier, Ivars Putnis, Marie C. Nordström
Wageningen University & Research

Despite long-standing interest, it remains poorly understood how food web structure varies through time, and how changes in species composition manifest at the food web level. Using 34-year biomonitoring data across trophic levels, coupled with information on species feeding relationships, we constructed time series of the food web in Gulf of Riga, a sub-basin of the Baltic Sea. We assessed the dynamics of food web by calculating an inclusive list of 28 qualitative and quantitative metrics. We found three main periods with similar food web characteristics, separated by pronounced shifts in food web structure. The first shift in the early 1990s was characterized by increases in complexity of quantitative food web structure, and demonstrated how previously documented structural reorganizations permeated through the food web. The second shift in the early 2000s was most strongly characterized by sudden increases in the complexity of qualitative food web structure caused by abrupt increases in the number of species. These findings demonstrate the complementarity of qualitative and quantitative metrics to describe the temporal variability in food web dynamics.

4. Evaluating stability of energy-flux food-web models

Daniëlle de Jonge*, Johan van de Koppel, Peter de Ruiter, Dick van Oevelen
NIOZ Royal Netherlands Institute for Sea Research / University of Groningen

Energy-flux food-web models are a type of ecological network representing trophic interactions among species as a flow of energy of material from one species to another. As species interactions influence the perpetuation of disturbances through a system, food web models can provide insight into ecosystem stability. Methods have been devised to translate the inherently static energy-flux models to the dynamic domain and assess stability. Stability is a powerful network characteristic to evaluate particularly in (anthropogenic) disturbance studies. However, the translation from mathematical concepts to ecological interpretation of stability contains limitations and potential pitfalls. Additionally, consistency in the definition of stability and reproducible code are currently lacking. In this talk, I will briefly summarize the concept of network stability and provide a small tutorial on assessing stability from energy-flux models including guidelines. I will furthermore focus on ecological interpretation and discuss avenues for future research.

5. Microbial network analysis – where do we stand?

Karoline Faust
KU Leuven / Rega Institute

The construction and analysis of microbial association networks from sequencing data is nowadays a standard tool in the toolbox of microbial ecologists. However, while microbial network analysis has to tackle the same challenges as network analysis in other domains, it also has to deal with additional domain-specific difficulties, such as compositional data and the scarcity of experimentally validated ecological interactions. Here, I will give an overview on the strengths, limitations and applications of microbial network analysis.

6. Learning from microbial association networks through clusters and conserved patterns

Lisa Röttjers, Karoline Faust
KU Leuven / Rega Institute

Microbial network analysis is an intuitive method for visualization and analysis of microbial communities. However, as microbial interactions are challenging to validate, microbial networks are often constructed from inferred associations and generally contain a high number of errors. To address these problems, we have developed two tools for investigation of noisy networks. The first, manta, is a novel heuristic network clustering algorithm that takes advantage of sign information. This algorithm can differentiate between weak and strong cluster assignments, making it an optimal choice for noisy networks. Our evaluation on simulated data shows that it outperforms or matches other popular algorithms, while our case studies demonstrate that the weak clustering provides new insights into community structure. Our second tool, anuran, is a toolbox for identification of conserved patterns across multiple networks. The toolbox constructs null models for each of the networks and tests whether properties of the inferred networks are different from expected. We use this toolbox on real-world data to demonstrate that a null model approach provides novel and robust insights into microbial communities. While we developed our toolboxes for microbial network analysis, we expect these techniques to be applicable to other noisy networks as well.

3d: Plastics in the Environment

Conveners: Oscar Franken (Vrije Universiteit Amsterdam)
Esperanza Huerta Lwanga (Wageningen University & Research)

1. Plastics in the environment – Session introduction and overview

Oscar Franken[1], Esperanza Huerta Lwanga[2]
[1]Vrije Universiteit Amsterdam / [2]Wageningen University & Research

Plastic pollution has recently gained a lot of media attention. Yet, the effects these plastics may have in both aquatic and terrestrial ecosystems are still largely unknown. Breakdown of larger particles can result in the formation of micro- and nano-plastics, which may affect species in direct and indirect ways. This session aims at bringing together and synthesizing the current ecological knowledge on the effects of plastic pollution in a wide range of ecosystems.

2. Effects of plastic mulch film residues on wheat growth and rhizosphere microbiome

Yueling Qi, Xiaomei Yang, Esperanza Huerta Lwanga, Paolina Garbeva, Violette Geissen
Wageningen University & Research

In the last decades, the use of plastic mulch film in (semi-) arid agricultural regions has strongly increased. Plastic residues from mulching remain and accumulate in soil that can lead to serious environment problems. Biodegradable plastic mulch films were produced as environmentally friendly alternative for solving plastic pollution in agricultural land. Microorganisms, in particular, rhizosphere bacteria play an important role in plant growth. However, the effects of polyethylene and biodegradable mulch film residues on plant growth and rhizosphere microbiome are still unknown. In this study, we performed a pot experiment to assess the effects of low density polyethylene (LDPE) and biodegradable plastic (Bio, made of polyethylene terephthalate, polybutylene terephthalate, pullulan) with macro- (5 mm2, Ma) and micro- (50 µm-1 mm, Mi) sizes on wheat growth and rhizosphere bacterial community. The results showed that plastic residues presented negative effects on both above- and below-ground parts for both vegetative and reproductive development. We also identified significant effects of Bio and LDPE plastic residues on the rhizosphere bacterial communities and on the blend of volatiles emitted in the rhizosphere. Our study provides evidence for impacts of plastic residues on the soil-plant system, suggesting urgent need for more research examining their environmental impacts on agroecosystems.

3. Exploring the impacts of polyester fibers and tire wear particles on soil invertebrates

Salla Selonen, Anita Jeme Kokalj, Kees van Gestel
Vrije Universiteit Amsterdam

According to recent estimates, the major part of microplastics in soil comprise of tire wear particles released by abrasion of car tires and synthetic fibers derived e.g. from sewage sludge based soil fertilizers and atmospheric deposition. However, despite their prevalence, the effects of these microplastics in the soil are still poorly understood. To shed light on this black box, we studied the effects of polyester fibers and tire wear particles on enchytraeids (*Enchytraeus crypticus*), earthworms (*Eisenia andrei*), springtails (*Folsomia candida*) and isopods (*Porcellio scaber*). In addition, the effects of these particles on the toxicity of the pesticide chlorpyrifos were studied. Although the effects of the studied particles on soil invertebrates during one generation time slot were slight, some notable observations were made, such as that the effects of microplastics on soil invertebrates are not always dependent on their ingestion, that the capability of microplastics to affect chemical toxicity depends on the type and concentration of the particle, and that soil invertebrates can modify the size distribution of microplastics. In this presentation, the key findings in the area of soil ecotoxicology in the project IMPASSE (Impacts of Microplastics on AgroSystems and Stream Environments; ERA-NET Cofund WaterWorks2015, Water JPI) are shown.

4. Assessing the Fate of Marine Plastics: Colonization and density change

Erik Zetter, Tracy Mincer, Scott Gallager, Michiel Klaassen, Linda Amaral-Zettler
NIOZ Royal Netherlands Institute for Sea Research / Utrecht University

Colonization of plastic in the ocean by "fouling" communities and subsequent sinking due to density changes is often cited as one of the mechanisms for removing PMD from the surface. However, there are relatively few studies that document sinking of buoyant plastic resulting from colonization by microbes and metazoans. We quantified density changes in plastic of various formats due to colonization by microbial cultures in the laboratory, and colonization by mixed communities in-situ. As expected, the shape of the plastic piece and consequent surface area to volume ratio had a major impact on results. Microbial biofilms alone increased the density of plastic, but changes were small enough that they would only cause sinking in pieces with very high SA:Vol ratios. Samples incubated in-situ in the sea developed a diverse community of microbes and metazoans that resulted in density increases and sinking, sometimes within weeks of exposure. Over time the fouling community increased and caused sinking in PMD with lower SA:Vol ratios. Our results suggest that fouling will selectively remove PMD based on resin density and the fragment size and shape, and that the impact will vary with location and season as the fouling community changes.

5. Accumulation, distribution and composition characteristics of macro-micro plastic particles in different mulching farmlands, Northwest China

Fanrong Meng, Tinglu Fan, Xiaomei Yang, Michel Riksen, Minggang Xu, Violette Geissen
Wageningen University & Research

Plastic mulch use in farmland is creating macroplastic (MaPs > 5mm) and microplastic (MiPs < 5mm) particles pollution and threatening soil quality. However, little is known about the dynamic of plastic debris in soils. Hence, we studied plastic debris in 0-30 cm soil of two regions in Northwest China, where plastic mulching is a common: Wutong Village (S1) characterized by small plots and low intensity tillage, and Shihezi (S2) characterized by large plots and intensive machinery tillage. MaPs and MiPs were collected and identified . The results showed that MaPs ranged from 30.3 kg·ha-1 to 82.3 kg·ha-1 and 63.3×104 p·ha-1 to 275.3×104 p·ha-1 in S1, ranged from 43.5 kg·ha-1 to 148 kg·ha-1, 461×104 p·ha-1 to 2 016 ×104 p·ha-1 in S2. The main MaPs size categories were 2-10 cm2 and 10-50 cm2 in S1, < 2 cm2 and 2-10 cm2 in S2. Concerning the mulching years, in S1, we found that 6-8 years continuous mulching fields accumulate more MaPs than over 30 years intermittent mulching fields; In S2, MaPs accumulate from 6 to 15 years mulching fields, from 15-18 years, MaPs number and content dropped due to MaPs become smaller and could not be recycled. MiPs were mainly detected in over 30 years mulching history fields in S1 and detected all the fields in S2. We conclude that that long-term cultivation, intense machinery tillage and irrigation lead to severer MiPs pollution. The results thus implied that different farming systems could alter the dynamic of agricultural plastic debris and further study should concern the impacts on soil quality from small MaPs (< 2 cm2) and MiPs.

6. Plastic mulch in agriculture: the case of low density polyethylene and its interactions with pesticides and soil microbiota

Nicolas Beriot, Raul Zornoza, Paul Zomer, Onurcan Ozbolat, Esperanza Huerta Lwanga, Violette Geissen
Wageningen University & Research

Low Density Polyethylene is the most applied plastic mulch in agriculture, for decreasing water evaporation, increasing soil temperature, or preventing weeds. Incomplete removal of polyethylene mulch causes plastic pollution in agricultural soils. In conventional agriculture the use of plastic mulch is combined with the use of pesticides. Little is known about the long term effects on soils of plastic debris accumulations in relation with pesticides residues. We studied 18 parcels in vegetable farms, under organic or conventional management, where plastic mulch has been used for 5 to 20 years in Cartagena's country side (SE Spain). We sampled soil at two depths: 0-10 cm and 10-30 cm. We compared the macro and micro plastic debris contents, the pesticides residue levels and the soil physiochemical properties between parcels. The ribosomal 16S and ITS DNA regions were sequenced to study shifts in bacterial and fungal communities, respectively. Soils under conventional management contained on average more than 6 different pesticides residues and soils in both managements contained on average 0.2±0.26 g/kg plastic debris. This study also showed how plastic and pesticides interact in soils and affect the microbial community. We identified the most sensitive groups which can act as bioindicators for plastic and pesticide pollution in soils.

Parallel Session 4

4a: Soil Organic Matter in a changing environment

Conveners: Maaike van Agtmaal (Louis Bolk Instituut)
Mariet Hefting (Utrecht University)

1. Global mycorrhizal plant distribution linked to terrestrial carbon stocks
Nadejda Soudzilovskaia, Cesar Terrer, Peter van Bodegom, Leho Tederso
Leiden University

Vegetation impacts on ecosystem functioning are mediated by mycorrhizas, plant-fungal associations formed by most plant species. Ecosystems dominated by distinct mycorrhizal types differ strongly in their biogeochemistry. Quantitative analyses of mycorrhizal impacts on ecosystem functioning are hindered by the scarcity of information on mycorrhizal distributions. We will present first global, high-resolution maps of distribution of mycorrhizal types, and show that human-induced transformations of Earth's ecosystems have reduced ectomycorrhizal vegetation, with potential ramifications to terrestrial carbon stocks. We show that arbuscular, ectomycorrhizal, and ericoid mycorrhizal vegetation store, respectively, 241±15, 100±17, and 7±1.8 GT carbon in aboveground biomass, and the impacts of CO2 fertilization on vegetation are constrained by soil nitrogen or phosphorus availability, with N-or P-limitation modulated by the type of mycorrhizal association. Soil carbon stocks in both topsoil and subsoil are positively related to the community-level biomass fraction of ectomycorrhizal plants, though the strength of this relationship varies across biomes. This work provides a benchmark for spatially explicit and globally quantitative assessments of mycorrhizal impacts on ecosystem functioning and biogeochemical cycling.

2. Ectomycorrhizal necromass decomposition: how interactions between cell wall chemical components affect the degradation process.
Riccardo Mancinelli, Peter van Bodegom, Nadejda Soudzilovskaia
Leiden University

Accumulation of Soil organic matter in forests may provide a unique natural opportunity to mitigate the increment of the atmospheric CO_2 predicted for the future decades. Ectomycorrhizal fungi are ubiquitous in temperate and boreal forests, and their extramatrical mycelium has been shown to be a dominant source of carbon to enter the total soil carbon pool, exceeding the input via leaf litter and fine root turnover. However, the role of ectomycorrhizal fungi and their interspecific differences in the formation of stable soil carbon pool remains unclear. Recently accumulating evidence suggests that ectomycorrhizal fungal species likely differ in their decomposition rate and in the amount of extremely slowly decomposing components, that are likely to contribute to stable soil carbon pool. We hypothesize that these differences could be explained by fungal traits, and specifically by the composition of the liable components (e.g. glucans, proteins), in fungal cell wall. Using a litter-bag approach we experimentally examined the rate of decomposition of six ectomycorrhizal species differing in their chemical as well as morphological traits. We show that the fungal species strongly differ in decomposition rate and will discuss how these differences are underpinned by the dynamic of liable cell wall components during the decomposition process.

3. How local and continental drivers influence carbon stocks in forest edges across Europe.
Camille Meeuwsen, Sanne Govaert, Kris Verheyen, Pieter Vangansbeke, Pieter De Frenne
Ghent University

Temperate forests play a key role in carbon cycling and sequestration. However, carbon allocation in forests can be affected by many drivers acting on different scales. On a continental scale, carbon stocks will be influenced by N-deposition and the macroclimate, which is gradually changing. On a local scale, species composition, management and edge effects will have an impact. Moreover, these local factors will drive the climate on the forest floor, the so-called microclimate, which subsequently will influence carbon allocation. Due to the complexity of the system, there is still a lack of information on how these drivers, acting on different scales, coincide and impact carbon sequestration. Therefore, we studied aboveground as well as belowground carbon stocks in 225 plots across Europe. Our data originate from 15 sites along a latitudinal and elevational gradient, covering large differences in both macroclimate and N-deposition. In all sites, we selected edge-to-core gradients in three forests with a different management intensity, enabling us to study the interplay between local drivers (e.g. microclimate, management and edge effects) and continental drivers (e.g. macroclimate and N-deposition). Here we present how different carbon stocks vary in forests throughout Europe and how coinciding local and continental factors influence carbon storage.

4. **Sensitivity of labile carbon fractions to tillage and organic matter management and their potential as comprehensive soil quality indicators across pedoclimatic conditions in Europe**
Giulia Bongiorno, Else Bünemann, Chidinma Oguejiofor, Jennifer Meier, Gerrit Gort, Rob Comans, Paul Mäder, Lijbert Brussaard, Ron de Goede
Wageningen University & Research

Soil quality is defined as the capacity of the soil to perform multiple functions, and can be assessed by measuring soil chemical, physical and biological parameters. Among these, labile organic carbon is considered to have a primary role in many soil functions. Our recent study (Bongiorno, 2019 Ecological Indicators) aimed at assessing the suitability of different labile carbon fractions, namely dissolved organic carbon (DOC), hydrophilic DOC (Hy-DOC), permanganate oxidizable carbon (POXC), hot water extractable carbon (HWEC), and particulate organic matter carbon (POMC) as soil quality indicators in agricultural systems. We tested their sensitivity to two agricultural management (tillage and organic matter input) in 10 European long-term field experiments (LTEs), and we assessed their correlation with physical, chemical and biological soil quality indicators linked to soil functions. We found that reduced tillage and high organic matter input increase concentrations of labile carbon fractions compared to conventional tillage and low organic matter addition. POXC and POMC were the most sensitive fractions to both tillage and organic matter input across the 10 European LTEs. In addition, POXC was the labile carbon fraction most strongly correlated with soil chemical (total organic carbon, total nitrogen, and cation exchange capacity), physical (water stable aggregates, bulk density) and biological parameters (microbial biomass carbon and nitrogen, soil basal and multiple substrate induced respiration, abundance and richness of nematodes, and microbial functional diversity) (Bongiorno, 2019 Molecular Biology). Furthermore, due of its relationship with microbial biomass, which was identified as one of the drivers for pathogen suppression in a conduced bioassay, POXC also showed linkages with soil suppressiveness (Bongiorno, 2019 Soil Biology and Biochemistry). We conclude that POXC represents a labile carbon fraction sensitive to soil management and that it is highly informative about total soil organic matter, nutrients, soil structure, and microbial pools and activity, and as such strongly links to nutrient cycling, carbon sequestration, habitat for biodiversity, erosion control and disease regulation/suppression (as shown in our SEM analyses). Moreover, POXC measurement is relatively cheap, fast and easy. Therefore, we suggest measuring POXC as the labile carbon fraction to be measured in soil quality assessment schemes. However, future studies should focus on understanding the nature of the compounds quantified with the POXC method.

5. **Degradation of SOM in cultivated peat soils, why is there no stabilization?**
Mariet Hefting, Joost Keuskamp, George Kowalchuk
Utrecht University

Drainage of peatlands for cultivation leads to soil subsidence and increased carbon emissions. Development of mitigating strategies for these negative effects require improved understanding of oxidation dynamics in drained peatlands. While initial dynamics are well-known, it is less clear what happens after peat has been transformed to secondary organic compounds through initial oxygen exposure. It is often assumed that drainage leads to a short peak in CO_2 emissions, experiments however show that these high emission rates are maintained throughout the entire conversion of organic peat to its inorganic constituents, indicating that no organic matter stabilization takes place during decomposition. This high degradation rate of oxidized peat samples deviates from the general pattern of organic matter dynamics where decay rates reduce with degradation stage. The apparent lack of SOM stabilization in peat soils can be explained with two concepts: 1) the turnover of microbial biomass is low in peat soils, increasing the proportion of maintenance respiration and decreasing the relative production of secondary compounds and 2) the absence of mineral material organo-mineral complexation. Understanding these differences in SOM dynamics between peat soils and mineral soils can result in a crucial guideline for peat oxidation reduction and assessment of peat oxidation risks.

6. **Organic matter in peatlands: effects of land use and management measures**
Joachim Deru, Jaap Bloem, Ron de Goede, Lijbert Brussaard, Nick van Eekeren
Louis Bolk Institute

In drained peat grasslands in use for dairy farming, mineralization of soil organic matter (SOM) generally exceeds SOM inputs, leading to a net emission of CO2 to the atmosphere. Change of land use, for example from dairy to semi-natural grasslands, or of farming management may influence SOM dynamics and related CO2 emission. To get insight in those processes, we measured SOM contents and soluble organic matter fractions in the top soil of twenty dairy grasslands and twenty semi-natural grasslands, and in field experiments including addition of different liming minerals, organic materials and comparison of drainage methods. Other soil quality parameters and grass N yields were measured as well. In the explorative land use study, no difference in SOM or potential C mineralization was found between dairy and semi-natural grasslands. However, potential C mineralization rates appeared to be principally bacterial driven in dairy and fungal driven in semi-natural grasslands, and in both types based on different soluble organic matter fractions. From the field experiments, we found that the choice of liming mineral and fertilizer can significantly influence the SOM dynamics. The use of submerged drains had no influence on SOM in the top soil.

4b: TRENDS in Biodiversity Research

Conveners: Patrick Jansen (Wageningen University & Research)
Koos Biesmeijer (Naturalis Biodiversity Center)

1. Flower-rich dikes as a valuable habitat for wild bees; a case study from the river Waal, the Netherlands

Constant Swinkels, Nils van Rooijen, Cyril Liebrand, Eric Visser, Hans de Kroon
Radboud University Nijmegen

Insect decline has recently received much attention worldwide. The question at hand is how to combat this decline. One solution might be turning existing landscape elements into flower-rich habitats. In the Netherlands, dikes are one such landscape element. However, surprisingly little is known on the value of flower-rich dikes for insect communities. In this study, we present a first exploration of plant community – bee community relationships on dikes and assess the potential value of flower-rich dikes for bees. We sampled bee communities and related them to the present plant community at 20 flower rich and 25 flower poor dike grasslands. With a single inventory in May 2019, we encountered 997 individuals belonging to 79 species of wild bees, including 14 red-listed species. In addition, we show that locations with an impoverished plant community also harbour an impoverished total bee community, where not just the rare species are absent but also the abundances of common species are lower. Together, our results indicate that flower-rich dikes are valuable wild bee habitat. Developing more flower-rich dikes could therefore greatly contribute to insect conservation.

2. Aerial arthropod abundance and diversity in strip cropping systems

Fogelina Cuperus, Dirk van Apeldoorn, Felix Bianchi, Walter Rossing
Wageningen University & Research

Crop diversification can support and restore biodiversity in agricultural landscapes (Beillouin et al. 2019; Sirami et al. 2019). Diversification can be integrated in farming systems by time (e.g. crop rotations), genes (e.g. crop varieties) and space (e.g. intercropping). A form of practically implementing diversity in space is strip cropping. Strip cropping is the practice of growing two or more species in alternate, multi-row strips wide enough to allow independent cultivation but narrow enough to support ecological interaction. This form of intercropping mimics a divers crop mosaic, yet can be managed by modern machinery. It enables diversity and continuity of food and shelter for arthropod communities in agricultural landscapes, without yield and farm profitability trade-offs. In this study we investigate the effects of strip cropping on aerial arthropod density and community composition. We combine data (2019) from three experimental strip cropping locations (Wageningen (6ha), Lelystad (6ha), Zeewolde (42ha)) and two sampling methods: malaise traps and sweep netting. Most striking finding was the large increase in the total number of individuals in strip cropping systems, compared to semi-large scale and large scale reference systems. The findings suggests that within field diversification has great potential in restoring arthropod communities, without yield or efficiency trade-offs.

3. Fine-scale habitat niches of wetland birds derived from country-wide Airborne Laser Scanning data

Zsófia Koma, Meiert Grootes, Christiaan Meijer, Arie Seijmonsbergen, Henk Sierdsema, Ruud Foppen & Daniel Kissling
University of Amsterdam

Wetlands are highly important as one of the most threatened habitats globally. Numerous bird species are highly dependent on certain habitat structures within wetlands, but this aspect is difficult to monitor in conservation management due to the lack of feasible ways to quantify fine-scale habitat structure. Airborne Laser Scanning (ALS), an active remote sensing technique, provides fine-scale data sources to map and monitor 3D habitat structure. Here, we investigate whether fine-scale habitat structures extracted from national-wide ALS data are able to characterize the habitat niches of selected wetland bird species (reed warbler, sedge warbler, great reed warbler, Savi's warbler, and bearded reedling). We calculated LiDAR metrics related to a) the density of undergrowth, b) the vegetation height and c) the structural heterogeneity of the reedbed. These metrics showed that horizontal variability of vegetation height and the amount of tall vegetation at a landscape scale are important to differentiate the habitat niches of these birds. Our study shows that ALS could be used to develop a new approach for quantifying habitat preferences of reedbed passerines and thus provide a better understanding of underlying drivers of their spatial distribution.

4. Analysis of a coastal North Sea fish community: comparison of aquatic environmental DNA concentrations to fish catches

Judith van Bleijswijk, Julia Engelmann, Lise Klunder, Harry Witte, Johannes Witte and Henk van der Veer
Royal Netherlands Institute for Sea Research

We performed a pilot study in coastal North Sea water and present comparative results from daily fyke catches (20 mm mesh) on two locations and results from weekly fish eDNA analyses on three locations within 2 km distance during the spring migration of fishes into the Wadden Sea. During ten weeks, from late April to early July, presence-absence calls of fishes based on weekly eDNA sampling at the NIOZ jetty significantly agreed with calls based on seven days of fyke fishing 1 km westwards. Seasonal patterns in eDNA concentration (12S rRNA gene copies/L) inferred from quantitative PCR and Illumina HiSeq community composition, corresponded to patterns in wet mass for the eight most abundant fish species in the fyke (>6 weeks present) despite changes in water temperature and changes in fish size class over the season. Small sandeel and gobies, which are important prey for large fishes and birds, were typically missed with the fyke but contributed up to about 40% of the total fish eDNA pool sampled at the NIOZ jetty and up to about 25% of the eDNA at two other locations.

5. Application of metabarcoding to determine the contribution of arthropod taxa to avian diets: validation with recorded diets

Yvonne I. Verkuil, Marion Nicolaus, Richard Ubels, Maurine Dietz, Jelmer Samplonius, Annabet Galema, Kim Kiekebos, Peter de Knijff, Christiaan Both
University of Groningen

Large-scale declines in arthropod diversity and abundance urges the need to understand its consequences on trophic interactions. Because monitoring diets is difficult in small predators with diverse diets, we aimed to test the quantitative accuracy of DNA-metabarcoding of faeces through understanding (digestive) biases and validation with recorded diets. In 39 camera sessions in the forests of Drenthe, The Netherlands, we documented food items delivered to nestling Pied Flycatchers by their parents. Faeces of these nestlings were metabarcoded with COI-barcoding primers, customized to avoid flycatcher DNA. We found that proportions of arthropod orders fed to nestlings on camera footage (approximated prey biomass) strongly correlated with the proportions in barcode reads. Within Lepidoptera, Diptera and Coleoptera, barcodes and camera records retrieved the same common families. The large similarity in gizzards and lower intestines of eight males, victims of competitors for nest boxes, established limited digestive bias. Our data show that DNA-metabarcoding can be used as a quantitative tool for diets of insectivorous birds. We applied this method to a few hundred adults in Drenthe throughout the nesting period. Adult diet was very different from nestling diet, also during provisioning. We discuss prey communities and the resolution of metabarcoding at lower taxonomic levels.

6. Towards open biodiversity data

Niels Raes
Netherlands Biodiversity Information Facility

With entering the Anthropocene, climatic conditions as well as human land use are rapidly changing resulting in the potential future loss of many species. To adequately monitor and predict the impacts of these changes there is a need for large quantities of free and open biodiversity data. This need was recognized 20 years ago with the establishment of the Global Biodiversity Information Facility – GBIF– that "enables users to navigate and put to use vast quantities of biodiversity information, advancing scientific research … serving the economic and quality-of-life interests of society, and providing a basis from which our knowledge of the natural world can grow rapidly and in a manner that avoids duplication of effort and expenditure." In 20 years GBIF has aggregated more than 1.3 billion biodiversity records. With developments in mobile technology this pool of data is rapidly growing and allows engagement of citizen scientists in collecting biodiversity data and monitoring changes in the natural environment. Currently, GBIF mediated data results in two scientific papers per day. I will provide a short overview of the activities of NLBIF towards open biodiversity data, and give a summary of the trends in 20 years of scientific research based on GBIF data.

4c: Recent Advances and Critical Topics in Reproductive Biology

Conveners: Melissah Rowe (Netherlands Institute of Ecology)
Lysanne Brouwer (Radboud University)
Yumi Nakadera (Vrije Universiteit Amsterdam)
Joris M. Koene (Vrije Universiteit Amsterdam)

1. Complex effects of multisensory pollution on sexual communication

Andrew Cronin, Rotem Zilber, Jacintha Ellers, Wouter Halfwerk
Vrije Universiteit Amsterdam

Urbanization is known to affect biotic and abiotic conditions with important consequences for species' survival and reproduction. Increased light and noise pollution are emblematic of a life in the city, and are in particular known to alter reproductive behavior. Urban animals often look, sound or move differently than their non-urban counterparts, presumably in response to changes in their sensory environment. Whether such urban-dependent signaling is adaptive or comes at additional costs is however less known. Here we examined the direct and indirect impacts of light and noise pollution on the calling behavior of the neotropical frog, *Engystomops pustulosus*, in the field. Through video and audio recordings, we documented changes in calling site attendance, as well as aspects of calling behavior depending on the sensory environment. These behavioral changes can have significant ramifications on reproductive output, and illustrate the influence of urban noise and light pollution as factors that can alter the evolution of secondary sexual traits.

2. Mechanisms underlying the seasonal onset of reproduction in a wild songbird

Melanie Lindner, Irene Verhagen, Veronika Laine, Heidi Viitaniemi, Kees van Oers, Arild Husby, Marcel Visser
Netherlands Institute of Ecology / University of Groningen

Climate change has significant impacts on natural populations, particularly on phenology traits, such as the seasonal onset of reproduction in birds. Using great tit females genomically selected for early and late reproduction, we study the fitness consequences of an advanced reproduction in the wild as well as the genomic and epigenomic basis underlying the onset of reproduction in climate-controlled aviaries. The combination of both will help to understand how seasonally reproducing songbirds will cope with future climate change.

3. Temperatures that sterilise males predict global distributions of *Drosophila* species

Steven Parratt, Benjamin Walsh, Amanda Bretman, Rhonda Snook, Tom Price
University of Liverpool

Climate change is a major threat to biodiversity, rapidly changing species distributions and threatening populations with extinction. A growing body of literature suggests that fertility is sensitive to high temperatures in many organisms, giving rise to the concept of "Thermal Fertility Limits" (TFLs). However, we do not know if TFLs vary among species, nor if TFLs correlate with lethal temperatures. We also do not know if temperature-induced sterility influences where species can live in nature. Here, we show that 24 of a panel of 41 species of *Drosophila* fruit flies lose fertility up to 4.5^{o}C cooler than lethal temperatures. We find that TFLs strongly predict species' global distributions with respect to the maximum temperatures they are likely to experience. This suggests that limits to fertility, rather than limits to survival, cryptically underpins organisms' thermal ecology. Our data also predict that many species have less capacity to buffer the effects of extreme temperature events in their native range than previously thought. These results highlight the valuable insights that reproductive ecology can provide for predicting and hopefully mitigating the impacts of global climate change.

4. Mate choice and reproductive success in a warming planet

Valentina Zizzari
University of Koblenz-Landau

Environmental changes can drastically affect animal life-history. Much information exists on the influence of thermal stress on the reproductive fitness of the exposed organisms. However, less is known about the effects of heat on the ability of choosy individuals to perceive and obtain reliable information about the potential mate. Animals employ a diverse range of sensory channels for intersexual communication, one of which is olfaction. We tested thermal sensitivity of sex pheromone communication and key reproductive traits in a species in which odours play a crucial role for mating decisions, the collembolan *Orchesella cincta*. Like many soil arthropods, *O. cincta* males advertise their presence to females by means of packets of sperm (spermatophores) deposited in the environment. A choosy female selects and picks up one spermatophore guided solely by the spermatophore-associated sex pheromone. Experimental evidence shows that some reproductive traits are more sensitive to heat stress than others. For instance, females were not attracted by spermatophores that had previously experienced heat stress, but individuals that picked up heat-stressed spermatophores did not produce less offspring. Although further research is needed, such findings suggest that susceptibility of reproductive traits varies among animals and likely depends on their mating system.

5. The mediating role of the placenta in antidepressant exposure in the live-bearing fish family Poeciliidae

Laura Staal, FJ Haan, Y Wang, SWS Gusselkloo, T Plösch, B Wertheim, BJA Pollux*, JDA Olivier*
University of Groningen

Selective Serotonin Reuptake Inhibitor (SSRI) antidepressants are found in surface waters and have been shown to affect ecologically relevant behaviors in fishes. It is not known whether these are the effects of changes in the expression of genes related to the serotonergic system. It is furthermore unknown to what extent antidepressant exposure influences reproduction and offspring development. To address this, we studied the effects of six-week SSRI exposure during pregnancy in concentrations varying between 0.1 and 40 µg/L in two live-bearing fish species (family Poeciliidae), one with (*P. turneri*) and one without placenta (*P. gracilis*). First, we quantified serotonin-1a receptor expression in the maternal brain. Second, we measured whole-body tissue concentrations of fluoxetine and norfluoxetine in pregnant females and their embryos to better understand the mediating role of the placenta in SSRI transmittance. Finally, we assessed developmental features of both embryos and offspring at birth. SSRI treatment negatively influenced fecundity, particularly at high concentrations. Gene expression and embryo development studies are still ongoing. Our preliminary data suggests that, like in mammals, the fish placenta does not protect the embryo against the SSRI exposure. Our study suggests that increased antidepressant use in humans is therefore likely to negatively impact the environment.

6. Reproductive ruin in the modern world?

Melissah Rowe, Lyanne Brouwer
Netherlands Institute of Ecology

Knowledge of reproductive biology is crucial to our understanding of organismal ecology and evolution. Such knowledge is particularly pertinent in modern times given that rapid environmental changes, such as increasing temperatures and urbanization, are negatively impacting biodiversity on a global scale. How do organisms cope with these changes? What effects do these changes have on reproductive ecology and evolution? And will these changes threaten fertility and fitness of individuals?

4d: Ecology of Social Behaviour

Conveners: Martijn Hammers (University of Groningen)
Sjouke Kingma (Wageningen University & Research)

1. Ecology of social behaviour

Martijn Hammers, Sjouke Anne Kingma
University of Groningen

Most organisms live in a social environment, and many aspects of their lives are affected by social interactions. Studying how ecological conditions affect cooperation and conflict between individuals is important for understanding life-history evolution, population dynamics and conservation. In this overarching presentation, we introduce and highlight the topics of this parallel session. We give illustrative examples of how ecological conditions shape different aspects of social behaviour in a wide variety of animals and highlight the importance of considering social behaviour in ecological studies.

2. Neurogenetic dissection of group formation: integrating cues from food, friends and foes

Thomas Verschut, Bregje Wertheim, Jean-Christophe Billeter
University of Groningen

Most organisms form social groups to increases their chances of survival and reproduction, but these benefits may have hidden costs when aggregation leads to overcrowding. Different sensory cues can provide information about these costs and benefits, but the mechanisms employed by the brain to integrate these different cues are poorly understood. In order to build a stronger interface between ecology and neuroscience we use fruit flies to study how the complexity of odors sensed during social interactions may lead to group joining or group avoidance. By using various behavioral assays, we have identified a panel of ecologically relevant cues, such as food odors, pheromones, and repellents that are indicative for group formation. In ongoing experiments, we are linking these odors to specific peripheral receptors and neuronal circuits.

3. Habitat fragmentation affects group living in an Afrotropical cooperative breeder

Laurence Cousseau, Dries van de Loock, Martijn Hammers, Erik Matthysen, Luc Lens
Ghent University

In cooperative breeding species, individuals delay dispersal and independent breeding and opt to help raising offspring that are not their own. Habitat fragmentation of pristine habitats may result in spatial variation in the costs and benefits of delayed dispersal which may affect the potential for cooperative breeding. Increased isolation may increase the cost of dispersal while reduced habitat size may decrease breeding opportunities in smaller fragments. These different processes may affect sociality in opposite directions. In addition, habitat fragmentation often implies habitat degradation which may reduce the benefits of philopatry in more degraded patches. We studied delayed dispersal and cooperation in the Afrotropical facultative cooperative breeding Placid greenbul, in the highly fragmented cloud forests of the Taita Hills (SE Kenya). We show that in small and degraded fragments, dispersal occur earlier than in large and more intact fragments. Unexpectedly, this did not affect group sizes. However, age structure and sex-ratio differed between large and small fragments. We explore how such variation in group composition affects cooperative breeding in this species.

4. Love thy neighbour, or not? – Spatial variation of density-dependent nest success in Eurasian oystercatcher

Magali Frauendorf, Andrew Allen, Bruno Ens, Eelke Jongejans, Erik Kleyheeg, Chris van Turnhout, Wolf Teunissen, Christian Kampichler, Jenny Cremer, Jeroen Nienhuis, Hans de Kroon, Martijn van de Pol
Netherlands Institute of Ecology / Centre for Avian Population Studies

Density-dependence is an important factor for understanding and managing population dynamics, with Allee effects being particularly influential for endangered species, as they may accelerate declines once a population is small. However, we have very little knowledge about spatial variation in Allee effects. Nest success is a vital rate known being density-dependent in many bird species, but the direction is expected to depend on behavioural mechanisms and predator community. Here, we quantify how the effect of conspecific breeding pair density on the nest success varies across the Netherlands in a mobbing species (*Haematopus ostralegus*) and tested whether spatial variation in density dependence can be explained by predator community. Our analyses shows there is no spatially consistent Allee effect on nest success at the meta-population level. The predator community explained spatial variation in density effects in the large-scale dataset, with nest success being lower when both breeding density and mammal dominance increased. However, this pattern was not consistent for the datasets from local sub-populations. Our results emphasize that declining oystercatcher population numbers are not driven by a positive density-effect at national scale and that it is dangerous to generalize results from a single local population for management implications and population models.

5. Recipient directed food calls in chimpanzees

Anne Marijke Schel, Zarin Machanda, Simon Townsend, Klaus Zuberbühler, Katie Slocombe
Utrecht University

Chimpanzees commonly produce food-associated calls and previous research suggests that chimpanzees are more likely to produce these calls when feeding in a party containing socially significant individuals (e.g. grooming partners). It is hypothesised that these calls function to strengthen affiliative bonds between certain individuals in manner analogous to grooming. To test whether food-associated calls are directed at specific socially valuable individuals, rather than indiscriminate broadcasts, we conducted a field experiment with wild chimpanzees of the Budongo Forest, Uganda. Using a playback paradigm, we presented silently feeding male chimpanzees with individually distinctive arrival pant hoots from familiar individuals and recorded their reactions. Our results showed that subjects were significantly more likely to respond with food calls to the simulated arrival of individuals with whom the caller had high rather than low levels of friendship and where there was a large rather than small positive dominance rank difference between the individuals. This study indicates that chimpanzee food-associated calls are not simply reflexive responses to food, but rather are selectively directed at socially important individuals.

6. Communal breeding and cooperation in Seychelles warblers is associated with nest predation risk, not survival benefits and food availability

Sjouke Anne Kingma, Kat Bebbington, Martijn Hammers, Frank Groenewoud, Hannah Dugdale, Marco van der Velde, Michael Taborsky, Terry Burke, Franz J. Weissing, David S. Richardson, Jan Komdeur
Wageningen University & Research

In communally-breeding animals, conflict over access to reproduction arises because the limited resources needed for survival and reproduction must be shared between dominant and subordinate group members. Reproductive concession models have been constructed to investigate how such conflict is resolved, and how communal breeding can be evolutionarily stable. These models predict that dominants should concede a share of reproduction to subordinates when this (1) increases the dominants' fitness and (2) prevents valuable subordinates from leaving the group. Demonstrable evidence of animals engaging in such reproductive concessions would have important implications for our understanding of the evolution of sociality across the animal kingdom, but has thus far been missing. Here, we show that dominant Seychelles warblers *Acrocephalus sechellensis* share reproduction in return for cooperative joint-protection of the nest and that such concessions promote group living and cooperation. Subordinates who help with incubation reduce the risk of egg predation and thus substantially increase group reproductive success in areas with high numbers of egg predators. Subordinates are more likely to gain access to reproduction within the group when predation risk is high. Since subordinates are more likely to stay and help in groups where they have the opportunity to reproduce, group living and cooperation are also more common in territories with high predation risk, regardless of food availability in the territory. Our results show that reproductive concessions can form part of a social contract between group members that underpins cooperative and communal breeding in social animals. Thus, while sociality is often considered to be selected for through habitat saturation or survival benefits derived from processes like safety-in-numbers and enhanced food processing, in Seychelles warblers sociality derives, at least partly, through reproductive benefits associated with reduced nest predation.

Poster titles and numbers

Please note that during the poster session on Tuesday all **odd-numbered** posters will be attended /discussed and on the poster session of Wednesday all **even-numbered** posters will be attended /discussed.

#	Name	Poster title
1	Lisanne van Willegen	Dune slacks conservation
2	Thomas Groen	When is variable importance estimation in species distribution modelling affected by spatial correlation?
3	Yumi Nakadera	Divergence of seminal fluid expression and function among natural populations of a freshwater snail species.
4	Madalina-Maria Vita	Elucidating fungal-bacterial interactions within compost
5	Luc De Bruyn	Partridge: Protecting the Area's Resources Through Researched Innovative Demonstration of Good Examples
6	Lilith Kramer	Zooming out: a network perspective on nutrient reduction measures
7	Stefanie Pflug	A new device to measure transpiration from plants in containers
8	Lisa Sánchez Aguilar	Illustration + design + ecology: using art as a catalyst for a new and ongoing scientific research
9	Luuk Croijmans	Diversifying agriculture to enhance biological control: reducing pest pressure by using strip cropping
10	Janne Nauta	Species distribution and biogeomorphological effects of *Lanice conchilega* in the Dutch Wadden Sea
11	Xiaohan Yin	Positive-xylem-pressure-generating species comes at costs of tree growth for accumulating NSC to repair embolism
12	Ke Chen	How do pollination and soil organic matter interactively affect raspberry production under diverse fertilizer levels?
13	Lilian Abreu	Wheat rhizosphere bacterial communities and protection against soil-borne pathogen
14	Jelle van Zweden	A future-proof citizen science plant monitoring scheme
15	Mandy Velthuis	Urban Algae: Ecological status and the perception of ecosystem services of urban ponds
16	Oscar Franken	CLIMECS: CLImatic Manipulation of ECosystem Samples
17	Isabelle Buyens	Facilitation, ecotypes and patchiness: how intraspecific responses to positive plant interactions determine patch dynamics at landscape scale
18	Juan Gallego-Zamorano	Assessing the impact of nitrogen deposition and land use on the distribution of plants
19	Annelies van Ginkel	Bird monitoring with drones
20	Nelleke Buitendijk	Managing geese through their landscape of fear: a suitable policy?

#	Name	Poster title
21	Claire Hermans	Bats in the spotlight: Behavioural response of bats to light intensity variation
22	Dieke Boezen	Plant virus diversity in Dutch natural ecosystems along a chronosequence
23	Thomas Lameris	Shorter-billed Knots in a warming Arctic – investigating causes and consequences
24	Tjisse van der Heide	Wadden Mosaic - Towards a deeper understanding of the subtidal Wadden Sea
25	Maarten Broekman	Quantifying extinction risks by linking habitat and abundance models: a case study of mammals in Madagascar
26	Mark Zwart	Living apart together: Ecological perspectives on the usual genome organization of multipartite plant viruses
27	Guido Leurs	Trophic niche overlap between benthic elasmobranchs and migratory waders in the Bijagos Archipelago, Guinea Bissau
28	Stijn van den Bergh	Mitigation of greenhouse gas emissions from agricultural soils by compost amendments, a field study
29	Azkia Nurfikari	Closing the loop: use of insect waste-streams to control soilborne diseases
30	Michiel Verhofstad	Artificially natural: A story about bank restoration in Dutch waterways
31	Joris Koene	Effect of artificial light on female reproduction in the pond snail *Lymnaea stagnalis*
32	Jip de Vries	Community composition drives community classification
33	Judith van Bleijswijk	Resemblance of fungal communities in air and sea water during a Sahara dust event
34	Esther Swankhuisen	Are tree logs scary? The behavioural responses of deer to tree logs in a human-dominated area
35	Rosanna van Hespen	Species variation in mangrove seedling establishment under sedimentary dynamic conditions
36	Virginia Sanchez Barranco	Trophic position, elemental ratios and nitrogen transfer in a planktonic host-parasite consumer food chain
37	Megan Korte	Facilitation as a driver of within-population variation in the annual grass *Brachypodium hybridum* in southeastern Spain
38	Karen Pedersen	Dung Beetles, Monkeys, and Trees, an Interconnected Web
39	Kyle Mason-Jones	Connecting bacteriophages to soil function
40	Arne van Eerden	Spoonbill migration
41	Benjamin Walsh	The impact of pupal thermal stress on fertility
42	Kiki Dethmers	Growing Cockles on Salinized Soils
43	Cristina Rotoni	Effect of bacteria and AMF from wild genotype on growth and root microbiome assembly of commercial cultivars of chrysanthemum
44	Hilde Vaessen	A landscape of the cyanobacteria problem

#	Name	Poster title
45	Shuwen Han	Evolutionary cross-protection among stressors: does adaptation of a plankton consumer to copper pollution mediate its performance response to warming?
46	Oumnya Cheriti	State of gastropods diversity in the North east of Algeria
47	Arnold Jose Lugo Carvajal	Cascading Effects of Forest Fires on Amazonian Fish Communities
48	Salomé Gonçalves Huq	Marsh Ecosystem Response to Increased Temperatures
49	István Fodor	Effects of progestogens on the neuroendocrine system of an invertebrate model species (*Lymnaea stagnalis*)
50	Lyanne Brouwer	Effects of urbanisation on birds in the Netherlands
51	Jens van Erp	Seabirds and wind farms: exploring year round bird flight to predict collision risk
52	Andrea Mulder	Seed dispersal by fish in temperate waters: a tracking study on common carp (*Cyprinus carpio*)
53	Haymanti Saha	Effect of light quality on mycorrhizal growth and resistance benefits
54	Paola Rallo	The genetic basis and ecological context of intraspecific variation in grass-microbiome interactions
55	Keli Li	Soil legacy effect on range shifting plants and related natives

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NERN Best Presentation Award Voting instructions

The Netherlands Ecological Research Network (NERN) will again award prizes for the best oral presentations given during the NAEM meeting, in the form of the "NERN Best Presentation Award". NERN has decided this to stimulate young academics to prepare and present an oral presentation of high quality. There will be a first (€ 300,-), second (€ 200,-) and third (€ 100,-) prize. The award ceremony will be during the closing session on Wednesday afternoon.

Who is eligible to win this prize?

All MSc students and PhD candidates, as well as those who have obtained their PhD degree after 13 February 2019 are eligible to take part in the competition. Note, however, that you can only participate if you will be present during the closing ceremony on Wednesday. When the above applies, you will automatically participate.

Evaluation criteria

All participants of the NAEM meeting can nominate their favourite presentation. Evaluation of the presentations should be based on the quality of the presentation style (voice, body language), content and the PowerPoint. Obviously, you can only nominate a presentation that you actually attended.

Evaluation / Selection procedure

The NAEM audience can cast their vote for the best presentation. One can only vote once during the two-day NAEM meeting. A special page on the NERN website will be used for this. The procedure is as follows:

- Scan the QR code below or type the following link in your internet browser of your laptop, tablet, or smartphone: https://www.nern.nl/presentation-award.
- Enter your personal invite code, as listed on the back of your name badge.
- Indicate your ranking of the three best presentations in your view.
- Note that you can only vote once, so you should not cast your vote until you attended all presentations or until you leave!
- You can cast your vote at any time during the meeting, up to Wednesday afternoon 16:30 hrs.
- The total number of votes for a given presentation will be corrected for the number of people present during that presentation.

SCAN THE QR CODE ABOVE TO CAST YOUR VOTE

NERN Best Poster Award
Voting instructions

The Netherlands Ecological Research Network will award prizes for the best poster presentations of the NAEM meeting. As usual, there will be a first (€ 150,-), second (€ 100,-) and third (€ 50,-) prize. The award ceremony will be during the closing session on Wednesday afternoon.

Who is eligible to win this prize?
All participants of NAEM that are presenting a poster during the meeting are eligible to take part in the competition. Note, however, that you can only participate if you will be present during the closing ceremony on Wednesday or when you have informed us about a representative that will be present during the ceremony to collect your prize.

Evaluation criteria
All participants of the NAEM meeting can nominate their favourite poster. Evaluation of the posters should be based on the quality of the content/impact, novelty, appeal, and clarity.

Evaluation / Selection procedure
The NAEM audience can cast their vote for the best poster. One can only vote once during the two-day NAEM meeting. A special page on the NERN website will be used for this. The procedure is as follows:

- Scan the QR code below or type the following link in your internet browser of your laptop, tablet, or smartphone: https://www.nern.nl/poster-award.
- Vote for the three posters that, in your opinion, were the top-3 best posters that were on display during the NAEM meeting.
- You can cast your vote at any time during the meeting, up to **Wednesday afternoon 14:00 hrs**.

SCAN THE QR CODE ABOVE TO CAST YOUR VOTE

NAEM 2020 BINGO

Welcome to the NAEM Bingo! This game is an initiative of the Future for Nature Academy, and is aimed especially at students and early-career scientists. To participate:

- Complete as many challenges as you can during the meeting. Keep notes about when, how or with whom you completed each challenge in the 'Notes' section on the back of the bingo card.
- Have fun, make new connections and enjoy the meeting!
- Submit your entry to the FFN Academy stand, latest 15:40 hrs (last break) on Wed 12 Feb.
- A panel of highly experienced bingo judges will determine three winners based on number of rows, columns and major diagonals completed.
- Prizes will be awarded during the 'Awards and Closing Ceremony' on Wed 12 Feb at 17:30 hrs.
- For any questions please find us at the FFN Academy stand.
- The NAEM 2020 Bingo was drafted by Mirjam van der Kruijt (FFN Academy – Velp), inspired by Jessica van der Wal's NAEM 2018 Bingo.

Tweet your Bingo accomplishments using **#NAEMbingo** and **#NAEM2020**

Enjoy NAEM 2020 and thanks for participating!

Future For Nature Academy

The Future For Nature Academy (FFN Academy) is a national network of students and young graduates with a passion for nature conservation. We organise various activities such as lectures, meetings with conservation heroes, documentary screenings and symposia, to create a platform for people to meet, discuss and make plans for a better Future For Nature. FFN Academy is aligned with the Conservation Optimism movement.

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NAEM 2020 Bingo – Challenges

Your name: Twitter name:
Email address: Institution:

	A	B	C	D
1	Tweet a picture of yourself in front of the FFN Academy stand using #NAEMbingo and #NAEM2020	Ask someone you don't already know to tell you the most unexpected thing that has occurred in their career	Have coffee/tea with someone you don't know at all, and ask them about their research	Write a sweet note and draw a koala for someone in a row in front of you
2	Mention at least one outdoor activity that the Future For Nature Academy has carried out in 2019	Take a short walk during one of the breaks and spot at least three different bird species	What was the most exciting thing you heard today? Tweet it using #NAEMbingo and #NAEM2020	Take a selfie with a speaker and tweet it using #NAEMbingo and #NAEM2020
3	Approach someone you don't know after their talk to express your enthusiasm about their work	Discuss whether it is worth saving a species from extinction. Tweet your conclusion using #NAEMbingo #NAEM2020	Tweet a photo of you giving your talk or poster presentation using #NAEMbingo #NAEM2020	Invite someone to your talk/poster, then follow up and ask if they have any feedback for you
4	Tweet a picture of yourself with 4 people, each from different institutions using #NAEMbingo and #NAEM2020	Draw a picture about someone's talk or poster, present it to him/her and tweet it using #NAEMbingo and #NAEM2020	Ask a random person how his/her day is going and which presentation was most impressive to him/her	Start a discussion about the merits of Conservation Optimism

NAEM 2020 Bingo – Notes

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1				
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