NAEM 2017

Netherlands Annual Ecology Meeting

14 & 15 February 2017

Congrescentrum De Werelt, Lunteren

- ***Programme***
- ***Presentation abstracts***
- ***Poster titles and numbers***
- ***List of participants***
- ***Presentation award instructions***

Programme

Tuesday 14 February

	Main Entrance Hall				
08:30	Registration and coffee in the Lounge and setting up posters				
	Europe Hall				
10:15	**Word of Welcome** • Louise Vet (Chair of the Meeting, Netherlands Institute of Ecology) • Ellen Decaestecker (NecoV, KU Leuven) Introduction to Plenary 1: Hans de Kroon (Radboud University Nijmegen)				
	Plenary 1: "Conserving biodiversity in agricultural landscapes: insights from opposite worlds"				
10:30	**1. Biodiversity in a changing world: maintaining and restoring biodiversity across Australia's agricultural landscapes** (**Margaret Mayfield**, University of Queensland)				
11.15	**2. In pursuit of biodiversity in agricultural landscapes in Europe** (**David Kleijn,** Wageningen University & Research)				
12:00	**Lunch in the restaurant**				
	Europe Hall	**America Hall**	**Asia Hall**	**Africa Hall**	**Vide Hall**
13:30	**Parallel 1a: Biodiversity and ecosystem functioning: beyond random extinction scenarios**	**Parallel 1b: Vector Ecology**	**Parallel 1c: Chemical communication in ecology**	**Parallel 1d: Modelling meets ecological application**	**Parallel 1e: WORKSHOP: Cultivating Serendipity**
	Conveners: 1. Fons van der Plas (Senckenberg Institute for Biodiversity) 2. Frederik De Laender (University of Namur) 3. Lander Baeten (Ghent University)	*Conveners*: 1. Erik Kleyheeg (Netherlands Institute of Ecology) 2. Robert Timmers (Utrecht University)	*Conveners*: 1. Olga Kostenko (Netherlands Institute of Ecology) 2. Kristin Schulz-Bohm (Netherlands Institute of Ecology) 3. Kay Moisan (Wageningen University & Research)	*Conveners*: 1. Jan Janse (PBL Netherlands Environmental Assessment Agency) 2. Sven Teurlincx (Netherlands Institute of Ecology) 3. Annette Janssen (Netherlands Institute of Ecology)	*Conveners:* 1. Gera Hol (Netherlands Institute of Ecology) 2. Elly Morriën (University of Amsterdam)
13:30	Reintroducing environmental change drivers in biodiversity–ecosystem functioning research (Frederik de Laender, University of Namur)	Mechanisms of vector ecology and consequences for spatial dynamics of transported organisms (Erik Kleyheeg, Netherlands Institute of Ecology))	Sniffing into volatile mediated communication and interaction (Paolina Garbeva, Netherlands Institute of Ecology & Simona Cristescu, Radboud University Nijmegen)	Ecological modelling (Annette Janssen, Netherlands Institute of Ecology)	Interactive introduction to the workshop - Serendipity: is it okay if things just happen? (Stijn van Gils, Netherlands Institute of Ecology)
13:50	On shaky ground: food web structure and drought sensitivity are too uncertain to predict climate change effects on soil carbon sequestration (Wouter Reyns, Hasselt University / University of Namur)	Zoonotic vector-borne pathogen prevalence in relation to vector burden and immune parameters in Wood mice and Bank voles (Esther Bügel & Bob Hendrikx, Wageningen University & Research)		Analysing cropping patterns for developing disease resistant landscapes: the case of potato and late blight (Francine Pacilly, Wageningen University & Research)	Mini-masterclass 'Serendipity' (Pek van Andel, University of Groningen)

14:10	Identifying the drivers of environmental-induced changes in biodiversity-ecosystem functioning relationships (Jan Baert, Ghent University / University of Namur)	Exploring the implications of climate change on epidemiological dynamics of multi-host vector-borne diseases (Yael Artzy-Randrup, Vrije Universiteit Amsterdam)	Microbe-based attraction of natural enemies to enhance biological control of pest insects (Tim Goelen, KU Leuven)	Management options for North Sea Shrimp fishery: Integrated modelling of ecology and exploitation (Tobias van Kooten, Wageningen University & Research)	Cultivating serendipity in life (Pek van Andel, University of Groningen)
14:30	Short Break				
14:40	Non-random extinction in an insect pollinated crop: losing the rare, not the dominant, crop pollinators (Thijs Fijen, Wageningen University & Research)	The 2016 Usutu virus outbreak among birds in the Netherlands; drivers of disease emergence (Chantal Reusken, Erasmus MC)	Full spectrum ant mimicry in facultative hyperparasitoid wasps (Bertanne Visser, Université Catholique de Louvain)	Drought and fire could arrest old-field succession in Mediterranean forests (Mara Baudena, Utrecht University)	Serendipity in Ecology - What is the secret of original scientists? (Marten Scheffer, Wageningen University & Research)
15:00	Extinction-driven changes in insular frugivore communities (Julia Heinen, Vrije Universiteit Amsterdam)	Virus population dynamics in freshwater ecosystems advance due to global warming (Thijs Frenken, Netherlands Institute of Ecology)	Host preference of mosquitoes mediated by skin bacterial volatiles (Niels Verhulst, Wageningen University & Research)	Unravelling processes steering vegetation development in Dutch floodplains: combining fieldwork, theoretical trait frameworks and models (Valeska Harezlak, University of Twente / Deltares)	Cultivating serendipity by mixing Arts & Science (Jasper van Ruijven, Wageningen University & Research)
15:20	Light in the undergrowth: Identity and diversity effects of tree species on light transmittance in forests (Bram Sercu, Ghent University)	Avian population responses to fragmentation and implications for forest ecosystems (Robert Timmers, Utrecht University)	The smell of defense: Intraspecific facilitation by allelochemicals in harmful algal blooms (Dedmer van de Waal, Netherlands Institute of Ecology)	A model approach to monitor the impact of soil subsidence on shorebirds (Bruno Ens, Dutch Centre for Field Ornithology)	Reflection time (Stijn van Gils, Netherlands Institute of Ecology)
15:40	**Coffee and tea in the lounge**				
	Europe Hall	**America Hall**	**Asia Hall**	**Africa Hall**	**Vide Hall**
16:00	**Parallel 2a: The effectiveness of the Ecosystem Services approach**	**Parallel 2b: From traits to ecosystem processes via remote sensing**	**Parallel 2c: THIS SESSION WAS UNFORTUNATELY CANCELLED**	**Parallel 2d: Carbon cycling in terrestrial ecosystems: from plot to global scale**	**Parallel 2e: Predicting evolution: state-of-the-art and novel interdisciplinary approaches**
	Conveners: 1. Marijke van Kuijk (Utrecht University) 2. Christiaan Hummel (Royal Netherlands Institute for Sea Research)	*Conveners*: 1. Gerlinde De Deyn (Wageningen University & Research) 2. Lammert Kooistra (Wageningen University & Research) 3. Peter van Bodegom (Leiden University)		*Conveners*: 1. Nadia Soudzilovskaia (Leiden University) 2. Ciska Veen (Netherlands Institute of Ecology)	*Conveners:* 1. Marcel Visser (Netherlands Institute of Ecology) 2. Jacintha Ellers (Vrije Universiteit Amsterdam)
16:00	The landscape approach: scientific challenges emerging from practice in low and middle income countries (Henk Simons & Joost van Montfort, IUCN NL)	Scaling from plant traits to ecosystem processes via remote sensing (Lammert Kooistra, Wageningen University & Research)		Carbon cycling in terrestrial, wetland and aquatic ecosystems: from plot to global scale (Tom Crowther, Netherlands Institute of Ecology)	Predicting Evolution: One of the game changers in the new Origins Center (Marcel Visser, Netherlands Institute of Ecology)

16:20	The role of ecosystem services in protected areas (Herman Hummel, Royal Netherlands Institute for Sea Research)	Remote sensing for quantifying plant traits at ITC, University of Twente (Roshanak Darvishzadeh, University of Twente)		Effect of warming on freshwater carbon cycling in macrophyte dominated systems (Mandy Velthuis, Netherlands Institute of Ecology)	Organics on Mars (Ingeloes ten Kate, Utrecht University)
16:40	The potential of voluntary market standards to conserve public and private values of natural capital (Mark van Oorschot, PBL Netherlands Environmental Assessment Agency)	Dunes from above: Relating patterns to dune building processes (Marinka van Puijenbroek, Wageningen University & Research)		The role of native and range-expanding plant communities in buffering the effects of drought on soil functioning (Marta Manrubia-Freixa, Netherlands Institute of Ecology)	Breaking through evolutionary constraint by variable environments (Marjon de Vos, Wageningen University & Research)
17:00	Short Break				
17:10	Rehabilitation of ecosystem services in agro-ecosystems through management adaptation (Vincent De Leijster, Utrecht University)	Predicting fire behaviour (in-) directly via plant traits and Remote Sensing (Luke Blauw, Vrije Universiteit Amsterdam)		Grass root abundance, not plant species richness, decreases fine root decomposition in an experimental grassland (Natalie Oram, Wageningen University & Research)	Evolution of range expanding plants (Mirka Macel, Radboud University Nijmegen)
17:30	Sandy solutions and solaces; what actually happened at the Sand Motor (Simeon Moons, Royal Netherlands Institute for Sea Research)	Monitoring vegetation height and greenness of low floodplain vegetation with a UAV (Wimala van Iersel, Utrecht University)		The role of phytoplankton productivity on the atmospheric CO2 flux of a eutrophic lake (Jolanda Verspagen, University of Amsterdam)	Explaining the apparent lack of micro-evolution in natural populations (Phillip Gienapp, Netherlands Institute of Ecology)
17:50	Documentation and analysis of ecosystem services in the Eastern Himalayan forests in India (Sayan Bhattacharya, Nalanda University)	Detecting soil microbial community shifts via remote sensing (Gera Hol, Netherlands Institute of Ecology)		Global patterns in above- and belowground ecosystem properties across montane grassland – forest ecotones (Ellen Cieraad, Leiden University)	Unravelling processes behind local adaptation: experimental evolution with spider mites (Karen Bisschop, University of Groningen / Ghent 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**				
	Europe Hall				
21:00	**<u>Evening Programme:</u> Why ecologists can save the planet, but are afraid to do it (Willem Ferwerda, Commonland)** What if the economy would include the real value of ecosystems? What if decision makers were using ecosystem science to enhance their decisions? What if farmers, investors and ecologists would work together? What if biodiversity was easy to explain to your mother-in-law? What if ecologists would use their socio-entrepreneur skills to create more promise for the commons… In this lecture Willem Ferwerda will touch upon answering these 'what if' questions. He will explore the promising future for ecosystem science, as in the 21st century ecology will finally be among one of the most popular professions ever.				

Wednesday 15 February

07:30	Breakfast in the restaurant				
08:00	Registration for those coming on Day 2 only				
	Europe Hall	**America Hall**	**Asia Hall**	**Africa Hall**	**Vide Hall**
08:30	**Parallel 3a: Plant community interactions**	**Parallel 3b: The host-microbiome: the unseen organ**	**Parallel 3c: Establishment ecology**	**Parallel 3d: Changing species interactions and ecosystem functioning in the Anthropocene**	**Parallel 3e: Benthic-pelagic coupling on shallow to deep reef ecosystems**
	Conveners: 1. Rocío Escobar-Bravo (Leiden University) 2. Saioa Legarrea (University of Amsterdam)	*Conveners*: 1. Silvia Cretoiu (University of Amsterdam) 2. Henk Bolhuis (Royal Netherlands Institute for Sea Research)	*Conveners*: 1. Zhenchang Zhu (Royal Netherlands Institute for Sea Research) 2. Tjisse van der Heide (Radboud University Nijmegen) 3. Tjeerd Bouma (Royal Netherlands Institute for Sea Research)	*Conveners*: 1. Wendy Jesse (Vrije Universiteit Amsterdam) 2. Estefania Velilla (Vrije Universiteit Amsterdam) 3. Lisette de Senerpont Domis (Netherlands Institute of Ecology)	*Conveners:* 1. Jasper de Goeij (University of Amsterdam) 2. Nicole de Voogd (Naturalis Biodiversity Center) 3. Arie Vonk (University of Amsterdam)
08:30	Can beneficial microbes help mitigate plant growth-defence trade-offs under shading? (Arjen Biere, Netherlands Institute of Ecology)	Symbiosis revisited: Sphagnum vs. its microbiome - Environmental controls on N2 fixation and Sphagnum performance in peatlands (Eva van den Elzen, Radboud University Nijmegen)	Establishment problems of foundation species: knowledge from coastal wetlands (Zhenchang Zhu, Royal Netherlands Institute for Sea Research)	Changing species interactions and ecosystem functioning in the Anthropocene (Lisette de Senerpont Domis, Netherlands Institute of Ecology)	Sponges bring life to shallow and deep coral reefs: From cells to ecosystems (Jasper de Goeij, University of Amsterdam)
08:50	Contrasting responses of insect communities to grazing intensity in lowland heathlands (Michiel Wallis de Vries, Wageningen University & Research)	Animal-microbiota dynamics vary across levels of biological organisation in wild birds (Pieter van Veelen, University of Groningen)	Biophysical interactions close the Window of Opportunity for tidal marsh establishment (Jim van Belzen, Royal Netherlands Institute for Sea Research)	Third generation sequencing as a tool for African great ape conservation (Ineke Knot, University of Amsterdam)	Survival in a feast-famine environment: Resource utilization and storage in cold-water coral Lophelia pertus (Sandra Maier, Royal Netherlands Institute of Sea Research)
09:10	How a specialist herbivore and competition affect the performance of invasive ragweed in Europe (Suzanne Lommen, University of Fribourg)	The role of the belowground plant microbiome in climate change induced range shifts (Kelly Ramirez, Netherlands Institute of Ecology)	Food or furniture – a study of an epiphyte and its invertebrate community (Annieke Borst, Radboud University Nijmegen)	Integration of exotic plants into native insect herbivore networks (Menno Schilthuizen, Naturalis Biodiversity Center)	Environmental and geological drivers of deep-sea sponge grounds (Ulrike Hanz, Royal Netherlands Institute for Sea Research / Utrecht University)
09:30	Short Break				
09:40	Omnivorous predator affects performance of herbivores through induced plant defences (Xiaoning Zhang, University of Amsterdam)	The persistent association of denitrifying Rhizobiales endophytes with Azolla: foul-play in the leaf pocket? (Laura Dijkhuizen, Utrecht University)	Steering community establishment – how do sowing and soil inoculation affect above - and belowground communities over two decades (Jasper Wubs, Netherlands Institute of Ecology)	Arsenic contamination in the groundwater and soil and subsequent transmission in the edible crops in Bengal Delta (Sayan Bhattacharya, Nalanda University)	Benthic-pelagic coupling in tropical seagrass meadows (Arie Vonk, University of Amsterdam)

10:00	Predicting soil legacy effects on plant communities and their herbivores (Robin Heinen, Netherlands Institute of Ecology)	Microbiome analysis of the soil immune response (Irene de Bruijn, Netherlands Institute of Ecology)	Harnessing or breaking facilitation: the dual role of positive interactions in coastal restoration (Valérie Reijers, Radboud University Nijmegen)	Joint effects of warming, terrestrial DOC, and atmospheric nitrogen deposition on mountain lake microbial communities (Marika Schulhof, University of California)	How cold-water coral mounds on the Rockall Bank have outgrown themselves (Furu Mienis, Royal Netherlands Institute for Sea Research / Utrecht University)
10:20	Mutualistic interactions mitigate impacts of drought and grazing on salt marsh vegetation (Marlous Derksen-Hooijberg, Radboud University Nijmegen)	Population-level profiling and analysis of the human microbiome (Leo Lahti, University of Turku)	The return of Flat oyster in North Sea and Dutch coastal waters: restoring a biocoenosis (Tom van der Have, Bureau Waardenburg)	The impact of artificial light at night on plant-pollinator interactions (Eva Knop, University of Bern)	Trophic interactions between fish, corals and algae on a reef in Kenya (Ronald Osinga, Wageningen University & Research)
10:40	**Coffee and tea in the lounge**				
	Europe Hall				
	Introduction to Plenary 2: Hans de Kroon (Radboud University Nijmegen) **Plenary 2: "What do phenotypic models of evolution tell us about reality?"**				
11:00	**1. What to do when one person cannot master all methods?** (**Hanna Kokko**, University of Zürich)				
11.45	**2. Is it important to worry about the molecular basis of evolving traits?** (**Sander van Doorn**, University of Groningen)				
12:30	**Lunch in the restaurant**				
13:30	**Poster Session 2: Even-numbered posters, which are linked to the sessions of the day, are presented and discussed**				
	Europe Hall	**America Hall**	**Asia Hall**	**Africa Hall**	**Vide Hall**
15:00	**Parallel 4a: Eco-Evolutionary Theory**	**Parallel 4b: New insights from large-scale ecology**	**Parallel 4c: Movement ecology in the Anthropocene**	**Parallel 4d: Trait-based approaches in community- and restoration ecology**	**Parallel 4e: NERN's national biodiversity knowledge agenda Nature4Life**
	Conveners: 1. Hanna ten Brink (University of Amsterdam) 2. Boris Kramer (University of Amsterdam)	*Conveners*: 1. Daniel Kissling (University of Amsterdam) 2. Hans ter Steege (Naturalis Biodiversity Center)	*Conveners*: 1. Thomas Lameris (Netherlands Institute of Ecology) 2. Frank van Langevelde (Wageningen University & Research) 3. Caspar van Leeuwen (Utrecht University)	*Conveners*: 1. Michiel Verhofstad (Netherlands Institute of Ecology) 2. Ralf Aben (Radboud University Nijmegen) 3. Jerry van Dijk (Utrecht University) 4. Oscar Franken (Vrije Universiteit Amsterdam)	*Conveners:* 1. Koos Biesmeijer (Naturalis Biodiversity Center) 2. Johan Mols (Naturalis Biodiversity Center) 3. Nieke Knoben (Naturalis Biodiversity Center)
15:00	A genetic matrix population model for eco-evolutionary dynamics (Charlotte de Vries, University of Amsterdam)	Recent progress in large-scale ecology (Daniel Kissling, University of Amsterdam)	Movement ecology in the Anthropocene – session introduction (Thomas Lameris, Netherlands Institute of Ecology)	Introducing trait-based approaches in community- and restoration ecology (Jerry van Dijk, Utrecht University)	Nature4Life Nationale Kennisagenda Biodiversiteit (Koos Biesmeijer, Naturalis Biodiversity Center)
15:20	Disentangling the contribution of natural selection and population regulation to patterns of phenotypic expression (Romain Richard, University of Amsterdam)	Phylogenetic signal for environmental niche drives the main plant biogeographic patterns of Amazonia (Kyle Dexter, University of Edinburgh)	Rapid evolution of phenology during the recent range expansion of a Mediterranean plant species (Nicky Lustenhouwer, ETH Zürich)	Traits-based estimates of diversity across different scales in tundra ecosystems (Eefje de Goede, Leiden University)	No title (Han Olff, University of Groningen)

15:40	A locally and regionally dynamic framework for community assembly (Alex Pigot, University of Groningen)	Identifying plant and animal traits shaping plant-frugivore networks across the Andes (Irene Bender, German Center for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig / Martin-Luther University Halle-Wittenberg / Senckenberg BiK-F)	Trees versus grass: cattle habitat preferences depend on climate (Edwin Bargeman, Wageningen University & Research)	Using root traits to explain changes in biodiversity effects over time (Lisette Bakker, Wageningen University & Research)	Multitrophic interactions: fundamental knowledge for sustainable food production (Joop van Loon, Wageningen University & Research)
16:00	Break				
16:10	Ignoring incipient species (Richel Bilderbeek, University of Groningen)	LiDAR remote sensing and functional diversity as applied in the Netherlands and the Amazon forest (Jesús Aguirre-Gutiérrez, Naturalis Biodiversity Center)	Individual modelling of a dolphin near extinction (Geerten Hengeveld, Wageningen University & Research)	From stress to process: species traits as predictor of hydrological effects on soil fauna and, subsequently, litter decomposition (Astra Ooms, Vrije Universiteit Amsterdam)	Nature4Life Nationale Kennisagenda Biodiversiteit (Peter de Ruiter, University of Amsterdam)
16:30	Fuel, cargo and the division of labour: a modelling approach (Lia Hemerik, Wageningen University & Research)	Frugivory and plant radiations: which ecologies promote speciation in the tropics? (Renske Onstein, University of Amsterdam)	Human-induced habitat changes influence multiple behavioural stages of dispersal in fragmented habitats (Hugo Robles, University of Antwerp)	Dispersal strategies of aquatic macroinvertebrates after restoration practices (Judith Westveer, University of Amsterdam)	Ecology for a circular economy (Louise Vet, Netherlands Institute of Ecology)
16:50	Estimating and interpreting migration of Amazonian forests (Edwin Pos, Utrecht University)	A framework for quantifying long-term 10-100ky environmental effects on biodiversity of volcanic and continental islands (Kenneth Rijsdijk, University of Amsterdam)	Limited dispersal evolves through environmental heterogeneity in harsh environments (Monique de Jager, Utrecht University)	Plant functional diversity and nutrient availability during fen restoration (Casper van Leeuwen, Utrecht University)	Green circles: nature as a partner on the road to sustainability (Paul Opdam, Wageningen University & Research)
	Europe Hall				
17:20	• **Awards ceremony** o NecoV Poster Prize (Maurice Hoffmann) o NERN Best Presentation Award (Member of the NERN Board) **Final words** (Louise Vet)				
	Lounge				
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 2017

Presentation Abstracts

Plenary Session 1

Conserving biodiversity in agricultural landscapes: insights from opposite worlds

Agriculture is the dominant form of land-use in many parts of the globe. Although biodiversity is much lower on farmland than in protected areas, small increases in biodiversity can have a large overall impact because it covers so much area. Furthermore, studies increasingly show that, through the provisioning of ecosystem services such as pollination and pest control, wild species contribute significantly to agricultural production. Key questions are therefore how we can effectively conserve farmland biodiversity and what species should we target?

1. **Biodiversity in a changing world: maintaining and restoring biodiversity across Australia's agricultural landscapes**
   (Margaret Mayfield, University of Queensland)

Biodiversity and associated ecosystem services are negatively impacted by land use changes associated with agricultural production. Throughout the Northern hemisphere, the importance of biodiversity conservation within agricultural areas is increasingly acknowledged. In other parts of the world, notably Australia, ecosystem service-based conservation in agricultural landscapes is still quite limited. In this talk, I explore biodiversity conservation in Australia's agricultural landscapes. Though Australia is one of the most sparsely populated continents (~2.8 people/km2 compared to 411.1 people/km2 in the Netherlands), agricultural land use change is extensive, impacting the vast majority of the continent in one way or another. Australia's recent history of European settlement, climate, biogeography and unique flora and fauna bring a suite of distinct conservation challenges to this country. Despite widespread agricultural land uses and known impacts of agriculture on biodiversity, most conservation in Australia still focuses on protected areas with relatively little known about or interest in protecting biodiversity in active agricultural landscapes. Even with research in this field expanding quickly, the idea that agricultural landscapes can have conservation value is not widespread. In this talk, I explore the causes and current solutions to common conservation issues in Australian agricultural landscapes. I focus on two specific topics: 1) insect pollinators in Australian agricultural landscapes and 2) the role of restoration in biodiversity and ecosystem service-based conservation. Finally, I discuss how public opinion and mainstream conservation thinking drive and restrict current conservation efforts in Australia's widespread agricultural landscapes.

2. **In pursuit of biodiversity in agricultural landscapes in Europe**
   (David Kleijn, Wageningen University & Research)

Agriculture is one of the main drivers of biodiversity decline. At the same time, agriculture depends heavily on wild species and natural processes. In Europe, conservation of farmland biodiversity is mainly being done through agri-environment schemes which cover a significant proportion of European farmland. While agri-environment schemes have been in place for decades, overall they have been unsuccessful at halting the biodiversity decline and there is little evidence that they have become more effective over time. Conservation ecologists often know exactly what ecological processes need to be manipulated to protect species or enhance biodiversity. We nevertheless fail to implement the right management in sufficient quantities in the right places. This is perhaps unsurprising considering the combined counteracting effects of the global economy, climate change, land-use change and the ever-changing political landscape. Approaches that aim to internalize biodiversity conservation into agricultural operations may be more effective as they may provide farmers with direct benefits of conservation management. For example, enhancing biodiversity on fruit farms can cost-effectively enhance crop yields through better pollination of crops. However, utilitarian approaches have limitations as well because it is difficult to value all aspects of biodiversity and benefits are often very context-dependent. Ultimately, the biggest threat to biodiversity conservation is the lack of public support. Conservation ecologists need to be aware that their work does not end with presenting the facts of their studies.

Plenary Session 2

What do phenotypic models of evolution tell us about reality?

Evolution is inherently difficult to study because it is a composite of processes that occur on different levels of biological organization, ranging from molecular to ecological. Evolutionary models traditionally reduce this complexity by assuming that traits have a simple genetic basis. In this way, development can be treated as a black box and evolution described at the level of the phenotype. We will discuss what we can and cannot learn from such phenotypic models and evaluate the need for a 'more modern synthesis' that takes into account the molecular basis of adaptation.

1. **What to do when one person cannot master all methods?**
   (Hanna Kokko, University of Zürich)

How well do we understand evolution? One (very) critical test is to stop merely asking whether we think we've understood why a certain set of traits evolved, but also whether we can say why something that would appear useful did not evolve in a specific taxon. Depending on who you ask, answers may vary from various phenotypic / ecological arguments to constraints posed by genetic architecture or perhaps insufficient additive genetic variation if the population is small. But who is right? It appears that a big problem plaguing our research may not be insufficient modelling skills, limitations of data acquisition or genomic methods, but the limitations of time and attention that makes none of us universally versed in all these methods. The remedy is obvious, but also difficult to achieve: more truly collaborative interaction between researchers with different skills. I will discuss these ideas with two examples: (1) how we should think about the recent surge of interest in epigenetic modifications' role in the adaptive process, and (2) how to understand migrant birds' evolutionary responses (or lack thereof) to recent climate change.

2. **Is it important to worry about the molecular basis of evolving traits?**
   (Sander van Doorn, University of Groningen)

The modern evolutionary synthesis provides a solid theory of selection, which allows us to describe accurately how a population with a given pattern of heritable variation will adapt over the course of a couple of generations. Yet, explaining, for example, why some characters are more variable than others, correlated to each other, or developmentally plastic remains a challenge. This makes it very hard to predict how the genetic architecture of evolving traits will change over somewhat longer timescales. Traditional theory is also ill-equipped to disentangle the relationship between molecular evolution and phenotypic adaptation, because it relies on simplistic models of the genotype-phenotype map. Being aware of these problems, the founding fathers of population genetics provided arguments for why phenotypic models are adequate for understanding evolution. Yet, several others have argued that evolutionary biology is in need of a theory of constraints just as much as a theory of selection. I will present examples from speciation theory and sensory ecology to illustrate this viewpoint, but will also highlight some of the obstacles on the road to developing more mechanistic models of evolution, motivated by recent work on the evolution of small signal transduction networks governing chemotactic movement in bacteria.

Parallel Session 1

1a: Biodiversity and ecosystem functioning: beyond random extinction scenarios

Conveners: Fons van der Plas (Senckenberg Institute for Biodiversity)
Frederik De Laender (University of Namur)
Lander Baeten (Ghent University)

1. Reintroducing environmental change drivers in biodiversity–ecosystem functioning research

Frederik de Laender
University of Namur

For the past 20 years, research on biodiversity and ecosystem functioning (B-EF) has only implicitly considered the role of environmental change. In this talk, I will illustrate how environmental change drivers are instigators of B change. Using model simulations, I illustrate that different environmental change drivers cause different B-EF trajectories and so predicting the functioning of ecosystems facing changes in B cannot be done without explicitly accounting for the underlying environmental change driver. Next, I present data from a recent meta-analysis that confirm a key prediction made by the models: environmental change can severely affect EF while leaving B unaltered but leaving compositional signals. I end by illustrating how randomised B manipulations can be combined with environmental change drivers in experiments to learn how initial B determines functional and compositional resistance to stress.

2. On shaky ground: food web structure and drought sensitivity are too uncertain to predict climate change effects on soil carbon sequestration

Wouter Reyns, Francois Rineau, Frederik de Laender
Hasselt University / University of Namur

Heathlands are semi-natural ecosystems able to store large quantities of carbon in their soils, making them valuable ecosystems to mitigate climate change by 'trapping' atmospheric CO2. The functional diversity of the microbial decomposer community determines the rate of carbon turnover vs. sequestration. Therefore, climate change induced extinctions significantly influence soil carbon sequestration. However, the consequences of drought for soil carbon sequestration in heathlands are highly uncertain due to knowledge gaps concerning the soil food web's structure and a lack of basic data on relative drought tolerances. Using a generalized Lotka-Volterra model of the soil food web, we illustrate that the soil carbon content increases (up to 175%) when predators are most sensitive and decreases (down to 60%) when decomposers are most or equally sensitive to drought. Moreover, these changes get augmented, smoothened and even reversed depending on the food web structure considered, representing different literature uncertainties. The two most important parameters accounting for this additional variation are the predator's feeding behaviour and the decomposer's contribution to polyphenols. Predicting how drought stress affects soil carbon budgets is thus at present impossible and data on drought tolerances, predator's feeding behaviour and decomposer's contribution to polyphenols are urgently needed to do so.

3. Identifying the drivers of environmental-induced changes in biodiversity-ecosystem functioning relationships

Jan Baert, Koen Sabbe, Colin Janssen, Frederik de Laender
Ghent University / University of Namur

There is now a growing consensus that ecosystem functions worldwide are under threat by ongoing biodiversity losses as hundreds of empirical studies reported a positive relationship between biodiversity and ecosystem functioning. Today, there is however mounting empirical evidence that the shape of biodiversity-ecosystem functioning (BEF) relationships also depend on the environmental conditions. However, the mechanisms underlying the environmental dependency of BEF relationships remain poorly understood. Species interactions shape biodiversity–ecosystem functioning relationships through species complementarity and dominance effects. Changes in per capita interactions under stress (as predicted by the stress gradient hypothesis) could therefore be a potential important driver of stress-induced changes in these relationships. To test this hypothesis, productivity was measured in microalgae communities along a diversity and herbicide gradient. On the basis of additive partitioning and a mechanistic community model, we demonstrate that changes in per capita interactions do not explain effects of herbicide stress on the biodiversity– productivity relationship. Instead, assuming that the per capita interactions remain unaffected by stress, causing changes in species densities to arise uniquely through differences in stress tolerance, sufficed to predict the observed stress-induced changes in the biodiversity–productivity relationship and community composition.

4. Non-random extinction in an insect pollinated crop: losing the rare, not the dominant, crop pollinators

Thijs Fijen, Bastiaen Boekelo, T. Boom, N. Janssen, D. Sanders, David Kleijn
Wageningen University & Research

There is compelling evidence that higher biodiversity delivers better ecosystem services such as crop pollination. The majority of crop pollination is usually delivered by a few common dominant pollinator species. However, less abundant pollinator species might still contribute significantly to the total pollination service, especially in crops with many potential pollinator species. By comparing the crop yields between species rich and species poor agricultural landscapes, we studied the effects of losing species on seed set and seed quality of leek (*Allium porrum*) in 36 production fields in France and Italy, and we studied how flower rich habitat increases pollinators in the fields. Cover of flower rich habitat in the landscape indeed strongly increased abundance of pollinators. The many less abundant species, and not the dominant species, disappeared from the leek fields with less flower rich habitat surrounding the fields. However, the dominant crop pollinators (mostly wild bumblebees species), as well as the small contribution of many, less abundant, pollinator species significantly increased seed set and seed quality. This study illustrates the need for more flower rich habitat in agricultural landscapes to increase the number of pollinators and pollinator species contributing to pollination of insect-pollinated crops.

5. Extinction-driven changes in insular frugivore communities

Julia Heinen, Emiel van Loon, Dennis Hansen, Daniel Kissling
Vrije Universiteit Amsterdam

The global decrease of biodiversity has led to large numbers of extinctions worldwide. The loss of species leads to the loss of mutualistic partners and ultimately the loss of important ecosystem processes, such as the dispersal of large seeds by large frugivores. The loss of frugivores is likely to be especially problematic on islands because they have experienced higher extinction rates compared to mainland ecosystems. We quantified extinctions of insular frugivores (birds, mammals, reptiles) globally and investigated extinction in relation to island characteristics (e.g. area, isolation, elevation) and functional traits of dispersers (diet, body mass, ability to fly). A database was constructed of 74 islands with 1183 occurrences of 385 frugivorous birds, mammals and reptiles and their traits. On 33 islands, extinctions took place and reduced the frugivore communities (birds, mammals, reptiles) by 34% on average, with small and isolated islands being affected most. Large and flightless species had a higher extinction probability. Extinctions of many large species within insular frugivore communities have on average reduced the mean body mass by 37% and the maximum mass by 51%. These non-random extinctions in insular frugivore communities will likely have severe consequences for seed dispersal processes and hence ecosystem functioning.

6. Light in the undergrowth: Identity and diversity effects of tree species on light transmittance in forests

Bram Sercu, Dries Bonte, Lander Baeten, Kris Verheyen
Ghent University

More diverse communities often have a higher primary productivity due to complementarity in resource use. It is however not well understood how this alters resource availability for other ecosystem processes. In forest ecosystems light transmitted to the forest floor is an important resource for understorey plants and has a tremendous impact on the microclimatic conditions on the forest floor. Tree species differ markedly in their light interception due to differences in crown architecture, density and physiology. We tested if the quantity of light transmitted to the forest floor is determined by the species composition via identity and diversity effects. We measured light transmission throughout spring with hemispherical images, and quantified tree and shrub cover in the Treeweb exploratory, a forest diversity platform with 53 plots consisting of seven or eight realizations for each combination of three regionally common tree species (*Quercus robur*, *Quercus rubra* and *Fagus sylvatica*). Crown cover differs between species combinations and is higher in mixtures due to a positive diversity effect in mixtures. Despite these observations, all species combinations have a similar average light transmission measured at the forest floor. Species do differ however in the within plot variability in light transmission.

1b: Vector Ecology

Conveners: Erik Kleyheeg (Netherlands Institute of Ecology)
Robert Timmers (Utrecht University)

1. Mechanisms of vector ecology and consequences for spatial dynamics of transported organisms

Erik Kleyheeg
Netherlands Institute of Ecology

Active movement behaviour is fundamental to the ecology of most animals, but also affects the organisms that are being passively transported. Mobile animals disperse a wide variety of less mobile animals, plant seeds, bacteria and viruses. As such, vectors play a crucial role in the spatial dynamics of numerous organisms, which is widely recognized in the fields of landscape ecology (animal-mediated seed dispersal) and disease ecology (spread of vector-borne diseases), but receives little attention as a concept in ecology. Deeper insights in the mechanisms and consequences of vector ecology will provide a better understanding of ecosystem functioning, community dynamics and host-pathogen interactions. Using waterbirds as an example of a model system used to study how vector ecology affects the spatial ecology of non-pathogenic organisms (e.g. plant seeds) and pathogenic organisms (e.g. avian influenza virus), the most important elements of vector ecology will be discussed. This session further explores the field of vector ecology by presentations covering various aspects of vector ecology, from vector movement and vector-pathogen interactions, to colonization by the dispersed organisms upon arrival in new habitat.

2. Zoonotic vector-borne pathogen prevalence in relation to vector burden and immune parameters in Wood mice and Bank voles

Esther Bügel & Bob Hendrikx, Kevin Matson, Tim Hofmeester
Wageningen University & Research

Over the past several decades, zoonotic diseases have increased in prevalence in the Netherlands. One example is Lyme disease, caused by a bacterial complex *Borrelia burgdorferi* s.l. that is vectored by the sheep tick (*Ixodes ricinus*). Bank voles (*Myodes glareolus*) and Wood mice (*Apodemus sylvaticus*), two of the most common rodent species in the Netherlands, are important hosts for ticks and thereby play a role in the maintenance of vector-borne pathogens like *Borrelia* spp. Disease transmission dynamics can depend on characteristics at both species and individual level due to host physiological and immunological variation. However many relationships between pathogen pressure and immune function in free living animals are currently unclear. To address this knowledge gap related to wild rodents in the spread of zoonotic diseases, 36 individuals were captured from previously studied areas differing in tick abundance. The individuals were evaluated for ectoparasite burden, pathogen exposure and immune function. In our study we found a high arthropod vector species variety and a difference in innate immune function between species. Better understanding relationships between vectors, pathogens and immune function in wild animals will contribute to a better understanding of natural disease dynamics of complex communities of wild animals.

3. Exploring the implications of climate change on epidemiological dynamics of multi-host vector-borne diseases

Yael Artzy-Randrup
Vrije Universiteit Amsterdam

Understanding how pathogen dynamics is affected by modes of transmission is critical for predicting disease emergence, pathogen persistence, and potential impacts of climate change. Here I study a model of two vector borne pathogen species in a multi-host community. I investigate their patterns of competitive exclusion and co-existence, where I also identify in- and out- of phase dynamics. I then discuss implications of these findings in climate change scenarios.

4. The 2016 Usutu virus outbreak among birds in the Netherlands; drivers of disease emergence

Jolianne Rijks, Marja Kik, Roy Slaterus, Ruud Foppen, Arjan Stroo, Jooske IJzer, Julia Stahl, Andrea Gröne, Marion Koopmans, Henk van der Jeugd, Chantal Reusken
Erasmus MC

In the summer of 2016, Belgium, France, Germany and the Netherlands reported widespread activity of Usutu virus, a virus transmitted by mosquitoes, based on live and dead bird surveillance. In the Netherlands, viral presence was detected through targeted surveillance in live birds as early as April 2016 while increased mortality in common blackbirds and captive grey owls was noticed from August 2016 onwards. In these birds USUV infection was confirmed by post-mortem examination and molecular detection. In collaboration with researchers from Germany, Belgium and France , a multi-country investigation was conducted. The causative USUV strains in the 2016 outbreak in Western Europe represented four lineages, of which two putative novel lineages were most likely recently introduced into Germany and spread to other western European countries. The spatial extent of the outbreak area corresponded with R0 values > 1. The occurrence of the outbreak, the largest USUV epizootic registered so far in Europe, allowed to improve insight in how a recently introduced arbovirus with potential public health implications can spread and become a resident pathogen in a naïve environment. The outbreak in the Netherlands coincided with above average temperatures in September and a mosquito abundance increasingly higher than in two previous years since June 2016. Temperature conditions influence both the developmental rate of mosquito vectors and the extrinsic incubation period of the virus in its mosquito hosts i.e. the time required for the development of the virus in its mosquito vector, from the time of uptake of the virus by the mosquito to the time when the mosquito is infective. Higher temperatures are considered a main driver of emergence of USUV and other related mosquito-borne viruses like West Nile virus. Understanding the ecological and epidemiological factors that drive the emergence or re-emergence of these viruses is critical to develop and implement timely surveillance strategies for adequate preventive and control measures. As the zoonotic potential of USUV becomes more and more apparent, public health authorities, blood transfusion services and clinicians in countries where USUV is actively circulating should be aware of the risk of possible USUV infection in humans, including in patients with unexplained encephalitis or other neurological impairments, especially during late summer when mosquito densities peak.

5. Virus population dynamics in freshwater ecosystems advance due to global warming

Thijs Frenken, Corina Brussaard, Mandy Velthuis, Ralf Aben, Garabet Kazanjian, Sabine Hilt, Sarian Kosten, Ellen Van Donk, Dedmer van de Waal
Netherlands Institute of Ecology

Viruses are ecologically important drivers of biodiversity and food web structure. Since viruses are obligatory parasites, their production depends on growth and metabolism of hosts and as such can be affected indirectly by global climate change. Specifically, climate change may alter top down control and thereby strengthen or weaken the coupling of host-virus interactions. Here, we investigated the effects of warming (4°C) on freshwater plankton and bacteria communities, and show how virus population dynamics relate to temporal changes in potential host communities. Warming led to higher virus abundances, which largely followed an earlier increase in bacterial host abundances. Also, virus population dynamics advanced significantly with 22 to 29 days in response to warming, which indicates that, not only primary producers and their associated bacterial communities advance due to warming, also the viruses infecting them do so. These results confirm the close coupling between viruses and their hosts, which does not seem to be affected by warming.

6. Disperser population responses to fragmentation and subsequent implications for forest ecosystems

Robert Timmers, Merel Soons, Pita Verweij, Marijke van Kuijk
Utrecht University

Fragmentation of natural landscapes has profound effects on biodiversity through a reduction in habitat, increased isolation and increased edge effects. Forested habitat in particular is prone to such effects due to its high species richness and greater land conversion rates than for any other ecosystem type. In order to gain a more complete understanding of how disperser populations respond to fragmentation we conducted a quantitative review. We focus on three diverse and globally distributed taxonomic groups: birds (*Aves*), bats (*Chiroptera*) and small mammals (*Rodentia* and *Marsupialia*). These taxa are pivotal for the pollination and dispersal of plants, regulate plant recruitment through predation of seeds and represent species of all trophic levels. Our approach allows us to compare disperser sensitivity to fragmentation relative to other functional guilds. Furthermore, we explore whether population responses depend on other species traits such as migratory status and habitat preference, and test whether protected areas are effective at mitigating the adverse impacts of fragmentation. Finally, the implications for forest ecosystems- including the dispersal of plants- are discussed.

1c: Chemical communication in Ecology

Conveners: Olga Kostenko (Netherlands Institute of Ecology)
Kristin Schulz-Bohm (Netherlands Institute of Ecology)
Kay Moisan (Wageningen University & Research)

1. Sniffing into volatile mediated communication and interaction

Paolina Garbeva & Simona Cristescu
Netherlands Institute of Ecology / Radboud University Nijmegen

Volatile organic compounds (VOCs) are commonly produced by all organisms including, human, animals, plants, fungi and bacteria. As compared to the soluble compounds that accumulate around the producing organism rather than diffusing into the surrounding environment, the volatiles can diffuse easily via air- and gas- filed pores and play important role in the long distance communication and interaction. In this talk we aim to provide succinct summary of the most common volatiles produced by plants and microorganism (such as sulphur VOCs, terpenes, nitrogen VOCs) their ecological role and importance in above- and belowground interspecies interactions and communication. Furthermore we will indicate the most promising approaches for trapping volatile used up to date and will highlight the potential of volatiles as biomarkers and novel agrochemicals for sustainable agriculture.

2. Sniffing into volatile mediated communication and interaction *(continued)*

Paolina Garbeva & Simona Cristescu
Netherlands Institute of Ecology / Radboud University Nijmegen

3. Microbe-based attraction of natural enemies to enhance biological control of pest insects

Tim Goelen, Hans Jacquemyn, Bart Lievens
KU Leuven

Land use can have a strong impact on biodiversity and ecosystem functioning. The full extent of the impact of management on soil biodiversity is often unknown. Determining that species went locally extinct can be extremely difficult, and the potential consequences of microbial species loss for soil functioning might be underestimated due to expected functional redundancy. In our experiments we tested the effect of microbial species loss on abiotic parameters, on plant productivity and plant quality and on disease control. One important mechanism in the natural control of soil-borne pathogenic fungi is the production of antifungal volatiles by bacteria. The abiotic parameters were mostly robust to species loss, while the effects on plant productivity and quality heavily depended on the origin of the microbial community. In contrast, the production of antifungal volatiles by bacterial communities was generally reduced when species loss occurred. Hyphal growth of the pathogen *Fusarium oxysporum* correlated negatively with bacterial diversity. Our findings suggest that microbial species loss can have severe consequences for plant productivity and disease control.

4. Full spectrum ant mimicry in facultative hyperparasitoid wasps

Bertanne Visser, Jeffrey Harvey
Université Catholique de Louvain

Chemical communication is of key importance to many species, whether to attract mates, to mark a territory or to deter predators. During this talk we will put forth recent work on the hyperparasitoid *Gelis agilis*, a parasitic wasp that facultatively parasitizes other parasitoids and which shows similarities in visual appearance and movement to the ant *Lasius niger*. Morphological similarity between *G. agilis* and *L. niger* led to the hypothesis that *G. agilis* mimics *L. niger* to reduce attack by visual predators. To test this hypothesis, choice and non-choice behavioural assays were performed using wolf spiders and various insect species as potential prey. Our results revealed that *G. agilis* was the only species, aside from *L. niger*, to successfully avoid spider attack. Further investigation then revealed that both species released the volatile compound sulcatone when threatened, a known insect defense semiochemical that acts as an alarm pheromone in ants. *G. agilis* thus exhibits an unusual multi-trait mimicry of ants, affording protection against ground-dwelling predators. We end our talk with an overview of our latest findings on sulcatone emission in other hyperparasitoids.

5. Host preference of mosquitoes mediated by skin bacterial volatiles

Niels Verhulst, Annette Busula, Willem Takken
Wageningen University & Research

Skin microbes are important in human health and disease. In vector-borne diseases the skin microbiota mediate the interaction between vertebrates and arthropod vectors. We have shown that odorants from the microbiota on the human skin guide anthropophilic malaria mosquitoes towards their blood-meal hosts. In this study we tested the attractiveness of natural and synthetic odour blends to mosquitoes with different host preferences and their response to volatiles released from skin bacteria. Different odour baits elicited varying responses among mosquito species in both semi-field and field setup. Synthetic odour blends were highly effective for trapping mosquitoes; however, not all

mosquitoes responded equally to the same odour blend. Volatiles from skin bacteria collected from different hosts and grown on agar plates induced differential responses of the anthropophilic *Anopheles gambiae* s.s. mosquito and more zoophilic *An. arabiensis*, which matched their response to the host odours themselves in the first series of experiments. Interestingly, *An. gambiae* had a specialized response to volatiles from four specific bacteria, common on the human skin, while *An. arabiensis* responded equally to all bacterial species tested. Skin bacterial volatiles may play an important role in guiding mosquitoes with different host preferences to their specific host. Identification of these bacterial volatiles can contribute to development of new synthetic odour blends that may be used for sampling of mosquitoes with different host preferences.

6. **The smell of defense: Intraspecific facilitation by allelochemicals in harmful algal blooms**
Dedmer van de Waal, Urban Tillmann, Jennifer Hülskötter, Tilman Alpermann, Sylke Wohlrab, Uwe John
Netherlands Institute of Ecology

With consensus emerging from experiments that generally support higher ecosystem stability in diverse assemblages, the key question has become whether such effect is real and important in natural ecosystems, especially those in which species diversity is threatened by anthropogenic global change. During this presentation, I will show (1) that plant diversity stabilizes the productivity of natural grasslands through asynchronous responses of species to environmental fluctuations, (2) that nutrient inputs threatens the stabilizing effect of diversity on ecosystem productivity, (3) that changes in plant diversity induced by global environmental changes are the key factor determining how global environmental changes affect ecosystem stability, and (4) that diverse communities are more stable because they exhibit resistance during extreme climate events. These findings indicate that there may be a universal impact of biodiversity on ecosystem stability with decreased plant species numbers leading to lower ecosystem stability. They also reveal underlying mechanisms on which scientists, land managers and politicians can act to stabilize ecosystem services in the face of global change.

1d: Modelling meets ecological application

Conveners: Jan Janse (PBL Netherlands Environmental Assessment Agency)
Sven Teurlincx (Netherlands Institute of Ecology)
Annette Janssen (Netherlands Institute of Ecology)

1. Ecological modelling

Annette Janssen, Jan Janse, Sven Teurlincx, Wolf Mooij
Netherlands Institute of Ecology

Ecosystem models play an important role in understanding the functioning of ecosystems. Their uses are many: developing hypotheses, testing concepts, filling in observation gaps and developing effective strategies for management and even the predicting future state of our ecosystems. Therefore, models may bridge a gap between theoretical and empirical communities. Theory is used to construct the models, and often empirical data and measurements are needed to feed and validate the results. This makes the model dependent on sound ecological theory as well as sound experimental data. By integrating the two, new insights may achieved. In this spirit, numerous models have been developed. This model diversity may be enormous, even within a specific field of research. Yet is it functional diversity? Are different models within the same field serving different purposes and are we as ecologists benefitting from this diversity or are we just getting lost in the woods of mathematical equations? These topics and more will be discussed in this keynote.

2. Analysing cropping patterns for developing disease resistant landscapes: the case of potato and late blight

Francine Pacilly, Jeroen Groot, Gert Jan Hofstede, Edith Lammerts van Bueren
Wageningen University & Research

Potato late blight (*Phytophthora infestans*) is one of the most important diseases in potato production and is responsible for major losses in yield. Because of its short life cycle and spore dispersal by wind, a late blight epidemic can spread over large regions in a short time. Nowadays the use of fungicides is the most important control method, but this involves high costs and they are harmful for the environment. Late blight resistant cultivars could play an important role in sustainable management of potato late blight, however, when these cultivars become more widely used, resistance breakdown can occur as a result of pathogen adaptation. In this project the host-pathogen system of potato - late blight was analysed as a model system to study management of crop-disease interactions. We used a modelling approach to analyse how potato yield, infection risk and resistance breakdown are affected by crop ratio and clustering of resistant cultivars, and by fungicide application. A simple model framework was developed to simulate crop growth and disease dynamics affected by weather conditions, using landscape data of an agricultural region in the Netherlands. In the presentation we will further discuss the model results and the implications for disease management.

3. Management options for North Sea Shrimp fishery: Integrated modelling of ecology and exploitation

Tobias van Kooten, Karen van de Wolfshaar, Karin van der Reijden, Brita Trapman, Josien Steenbergen
Wageningen University & Research

The fishery for brown shrimp (*Crangon crangon*) is an important fishery along the Dutch, German and Danish North Sea coast. It also occurs frequently in protected areas such as the Wadden Sea. Currently, there is (almost) no management. However, both the industry itself and other stakeholders are interested in implementing management, but for contrasting reasons. We used a combination of fleet distribution data and targeted interviews with fishermen to develop a mechanistic model of fishermen behaviour, and coupled this to an individual-based population model for brown shrimp. In this 'socio-ecological' model, we tested a number of management strategies, and evaluate their efficiency in contributing to the management aims of the various stakeholders. The high degree of mechanism in the fleet component allows us to differentiate between various management measures which would be considered identical when only the ecology is considered, such as reduced number of vessels, versus reduced fishing time per vessel. Our results show that the various possible ways to reduce fishing pressure can have very different results, both for the stock and for the fishermen. Furthermore, we show that a strong reduction in exploitation can lead to a stunted and unharvestable shrimp population, and that this risk is the result of human interference elsewhere in the North Sea.

4. Drought and fire could arrest old-field succession in Mediterranean forests

Mara Baudena, Victor Santana, Jaime Baeza, Susana Bautista, Maarten Eppinga, Ángeles Mayor, Ana Vasques, Alejandro Valdecantos, Ramon Vallejo, Max Rietkerk
Utrecht University

In the Mediterranean basin, following extensive land abandonment during the last century, a lot of old-field successional communities that are fire prone, developed. While natural succession is expected to culminate into a closed (oak) forest, observations suggest that fires could potentially divert it into an undesired state, dominated by small-size shrubs and herbs. This open shrubland is possibly maintained by a positive feedback between fire and vegetation composition, due to its flammability and fast growth rates. Increased aridity conditions, expected in the Mediterranean basin, are likely to reinforce this feedback, as they damage mostly late successional, forest species, and increase the chances of fire. To assess whether plant succession can be arrested by the combined action of fires and aridity, we introduce a new model, calibrated with observational data. We show that the Mediterranean oak forest is very resilient to the separate action of fires or increased aridity. However, the combination of the two drivers arrest succession, leading in the most extreme aridity scenarios to a stable open shrubland that sustains itself through increased fire occurrence. This result, obtained by long-term modelling runs, confirms the hypothesis generated by currently available, shorter-term observation, and can thus inform management practice for restoration.

5. Unravelling processes steering vegetation development in Dutch floodplains: combining fieldwork, theoretical trait frameworks and models

Valeska Harezlak, Denie Augustijn, Gertjan Geerling, Rob Leuven
University of Twente / Deltares

Contrasting the cyclic rejuvenation of riparian vegetation along natural flowing rivers, vegetation in floodplains along Dutch regulated rivers matures to its climax succession stage. This climax stage yields high hydraulic roughness and low water storage capacity and hence, jeopardizes water safety during high water discharges. Such situations are averted by for example clearing floodplain trees, floodplain excavation and grazing. Unfortunately, the efficiency of those activities is lacking clear understanding. Moreover, other valuable ecosystem services of floodplains, like biodiversity, carbon sequestration and water purification, are often overlooked. Models can be useful for selecting effective measures and optimizing ecosystem services. A sensible modelling approach is the trait-based approach: it holds the premise that processes are directly linked to plant strategies and that it is not species specific. But like other models, this model type must be fed with knowledge. Therefore, fieldwork has been undertaken in 3 Dutch floodplains containing 30 permanent plots. Within those plots, besides (proxies of) processes, like soil water content, substrate, soil nutrients, plant traits such as specific leaf area, C/N ratio and life history traits (based on vegetation mappings), have been measured. During the presentation I will focus on my fieldwork results, how they fit in with present day theoretical frameworks and how to incorporate this knowledge into a model useful to river managers.

6. A model approach to monitor the impact of soil subsidence on shorebirds

Bruno Ens, Marcel Kersten, Johan Krol, Jaap van der Meer, Jeroen Wijsman, Hans Schekkerman, Cor Smit, Kees Rappoldt
SOVON: Dutch Centre for Field Ornithology

Gas extraction may impact the birds feeding on the intertidal flats of the Dutch Wadden Sea due to soil subsidence. A monitoring program has been implemented to measure significant effects. If so, it may be decided to reduce or even stop the gas extraction. This is described as monitoring with the hand on the tap. The problem at hand is to devise the best way to monitor with the hand on the tap. Initially, we followed a purely statistical approach using a BACI design. Proper randomly assigned control areas are hard to find and statistically significant results offer no insight whether soil subsidence is the underlying cause of the observed difference in bird numbers. It was therefore concluded that this approach was unsatisfactory and we changed course. Using ecological modelling we integrate information from monitoring programs on bathymetry, water levels, weather, abiotic conditions, benthic fauna and birds to arrive at what we call proxies for carrying capacity for a selected set of bird species. Our current research effort is focussing on identifying the best proxy for each of these species.

1e : Workshop Cultivating Serendipity

Conveners: Gera Hol (Netherlands Institute of Ecology)
Elly Morriën (University of Amsterdam)

1. Interactive introduction to the workshop - Serendipity: is it okay if things just happen?

Stijn van Gils
Netherlands Institute of Ecology

Scientists often claim that their own work is built on a logical work flow and that they base their opinion on facts and sound arguments. Various studies, however, shows that human beings often make decisions based on intuition and that human brains construct the argumentation for these decisions afterwards. In addition, many – by the scientific community commonly seen as – great discoveries were not even based on intuition, but were in fact just the result of accidents. One could perceive this natural human behaviour and dependency on accidents as problematic for the development of science, but there are also scientists who claim that they could use these 'things that just happen' in order to improve the scientific process. During this workshop I will try to discover the audience opinion on scientific discoveries that just happen. I am not aware of a general conclusion of this workshop yet, but perhaps we will make a valuable or interesting discovery by accident.

2. Mini-masterclass 'Serendipity'

Pek van Andel
University of Groningen

Serendipity is an unsought finding or the art making an unsought finding. The word was coined by British Walpole in 1754. The term was first only used by in literary circles. Cannon introduced the term in the experimental sciences in 1945. Merton did this in behavioural sciences. Serendipity starts with a surprising observation followed by a correct explanation. The trigger is a riddle, an anomaly, or a novelty. The unsought finding can be a discovery (in science), an invention (in technique), or a creation (in art). Serendipity and systematic research do not exclude, but complement and even reinforce each other.

3. Cultivating serendipity in life

Pek van Andel
University of Groningen

'One can't look for the unknown, because then you don't know, where to look for' as the Sofists knew already. Therefore 'one has to expect the unexpected' as Heraclitus said. But you can only find the unexpected, when you know what you expect. Therefore it helps, when you are erudite (= not rude any more), by knowledge, experience, insight and vision. You can't program serendipity, then it wouldn't be serendipity anymore, but when you do a surprising observation you must have ànd take the time ànd the freedom to find the correct explanation. By doing 'Friday afternoon experiments', for example.

4. Serendipity in Ecology - What is the secret of original scientists?

Marten Scheffer
Wageningen University & Research

Originality is a prerequisite for world-changing science and arts alike, but it cannot be taught. Or can it? I will reflect on a set of habits –surprisingly- shared among successful artists and scientists may catalyse creative output. I highlight three groups of such habits, each corresponding to a cluster of personality traits, shown to be shared by creative artists and scientists. The first habit group 'embrace the unexpected' corresponds to the character trait 'openness to new experiences' and encompasses tendencies to go ahead without a plan, collect diverse experiences and take risk. The second group 'create conditions for creation' links to personality trait 'autonomous' and encompasses simple habits such as making empty time and carrying a notebook. The third class of habits 'break away from dogma' links to the shared personality trait 'norm-doubting' and stands for a strong drive to escape from established systems and also occasionally destroy part of one's own work to break tunnel vision and start anew. Although personality traits are hard to change, these habits hint at techniques or skills that may be taught.

5. Cultivating serendipity by mixing Arts & Science

Jasper van Ruijven
Wageningen University & Research

Thinking techniques like logic and deduction are clearly important to develop a scientific theory, but it all starts with a new idea. So how do we get these new ideas? Ultimately, an idea is a novel association, a new link between existing concepts. How are these associations formed? Are they just lucky accidents? As Louis Pasteur allegedly said, "Luck favours the prepared mind". The question then is how to prepare the mind. Of course, there is no single answer, but some answers are surprisingly simple: just take a stroll, for example. What many answers have in common, is changing perspectives. In my talk, I will highlight a number of examples of how to take a new perspective, focusing on exchange between arts and science. The emergence of a new idea may be hard to predict, but we can increase the chance that it does.

6. Reflection time

Stijn van Gils
Netherlands Institute of Ecology

Parallel Session 2

2a: The effectiveness of the Ecosystem Services approach

Conveners: Marijke van Kuijk (Utrecht University)
Christiaan Hummel (Royal Netherlands Institute for Sea Research)

1. The landscape approach: scientific challenges emerging from practice in low and middle income countries

Henk Simons & Joost van Montfort
IUCN NL

The landscape approach is an increasingly important tool for long term sustainable land use planning in nature conservation approaches. IUCN NL is involved in concrete applications of this approach in several of the most biodiverse landscapes in Africa, Asia and South America. As part of the world wide IUCN network of non-governmental organisations, governments, and scientific institutions IUCN NL is keen to incorporate state-of-the-art scientific knowledge in the landscape approach. In this presentation, experiences and views from practice and scientific challenges emerging from field practice are highlighted for discussion and exchange.

2. The role of ecosystem services in protected areas

Herman Hummel, Jaap van der Meer, Antonello Provenzale, Ghada El Serafy
Royal Netherlands Institute for Sea Research

Marine and terrestrial ecosystems play an increasing role in the provision of essential services to human wellbeing and societies. Over the last decades, however, intense anthropogenic pressure caused serious threats to ecosystems. The designation of Protected Areas may help to counterbalance the degradation and associated loss of Ecosystem Services. In the EcoPotential project, the environmental status of Protected Areas, together with its Ecosystem Services and their changes, will be assessed by a series of variables or proxies. The Protected Areas under study have different protection levels across a broad range of biogeographic settings and environmental conditions. This will allow to test the effectiveness of an Ecosystem Services approach as well as to define the general requirements and criteria for eventually improving the protection level of current, and potentially future, protected areas. Main conclusion is that social and economic factors need to be more emphasized and integrated with the abiotic and biotic factors influencing Ecosystem Services in protected areas. Taking into account the social and economic needs of Ecosystem Services beneficiaries, this study will help supporting the assessment of factors, including Ecosystem Services, which can set or alter management strategies and policy options for current and novel Protected Areas.

3. The potential of voluntary market standards to conserve public and private values of natural capital

Mark van Oorschot, Marcel Kok, Pieter van Beukering, Jolanda van de Berg, Eric Arets, Verina Ingram
PBL Netherlands Environmental Assessment Agency

Natural resources are increasingly obtained from remote, tele-connected production regions. Producing tropical resources like soy, palm oil, cacao and wood has several negative effects on natural and semi-natural ecosystems. Through environmental pressures and habitat conversion, ecosystems loose part of their capacity to provide valuable goods and services to society. Forests are a well-known example; they deliver goods like wood and fuel for economic use, and serve society by storing carbon and providing drinking water. When forests are not managed sustainably, their capacity to provide these services is partly lost. Numerous companies that import resources use certification with market standards to assure a responsible resource supply chain. Extended cost-benefit analyses were used to analyse the public and private costs and benefits of certified production, explicitly including ecosystem services from natural and altered ecosystems. Monetising the different functions provides information about why and for whom nature and biodiversity should be conserved, and provides insights for the role of private and public actors in better managing ecosystems.

4. Rehabilitation of ecosystem services in agro-ecosystems through management adaptation

Vincent De Leijster, Maria Ferreira Dos Santos, Pita Verweij, Martin Wassen
Utrecht University

The acknowledgement of the need to maintain ecosystem services (ES), and more specifically to conserve the ecosystem services providers (ESP) in agro-ecosystems is increasing. However, there are still many gaps in the knowledge on how management can influence the delivery of the ES and how the ES affect the agricultural productivity. A novel approach to study the full ecological mechanism of ES rehabilitation in agro-ecosystems, subdivides the ES in three components; ecosystem service providers (ESP), functional ecological processes (the ecosystem service itself) and functional

performance. This approach shows that management can influence the delivery of the service, and that the functional performance of the service influences the agricultural production. The mapping of the relation between agricultural management and ecological mechanisms is discussed according to two distinct woody-crop systems; coffee and almonds. In the case of coffee, the management decision to grow the coffee under shade or in full-sun results in strong differences in the ecological functioning of the agro-ecosystem, which in its turn affects the profitability. In the case of almonds the effect of the decision making in soil management strategy on ES provisioning will be emphasised. Upcoming research will provide more answers to unravel these complex mechanisms.

Management, ecosystem service profit – approach. This schema visualises how management strategy is the first link in the chain of agro-ecosystem services. The management strategy can influence the presence of ecosystem service providers (like bees). The ES providers on their turn carry out the actual functional process, the ecosystem service (pollination). This functional process leads to a performance (fruit set), that can lead to an impact on the productivity or profitability of agro-ecosystem.

5. Sandy solutions and solaces; what actually happened at the Sand Motor

Simeon Moons, Marinka van Puijenbroek, Alexander van Oudenhoven
Royal Netherlands Institute for Sea Research

The coastal zone is the most densely populated area in the world. The coastal ecosystem has contributed to increased human wellbeing throughout history. Fish and shellfish are a welcome food source; coastal vegetation and biogenic reefs provide flood protection; drinking water can be found underneath the dunes; and the area is a hotspot for leisure and recreation. These ecosystem services rely on a large number of species and characteristics that keep the system functioning. Unfortunately, many coastal ecosystems are under pressure from sea level rise and urbanization, causing a decline in coastal habitat and their associated services. Consequently, many (mega)cities around the world now face serious flooding threats. In response, sand nourishments are increasingly being used to protect urban areas from flooding. This sandy solution leaves many natural processes intact, in contrast to hard coastal defence structures, but it is a disturbance nonetheless. The Sand Motor, a unique mega-nourishment constructed in 2011, was designed to incorporate natural processes, minimizing ecosystem disturbance and optimizing ecosystem services for fisheries, flood protection and recreation. In this talk we will critically discuss the effectiveness of the Sand Motor design in providing these services thus far.

6. Documentation and analysis of ecosystem services in the Eastern Himalayan forests in India

Sayan Bhattacharya
Nalanda University

Eastern Himalayan biodiversity is highly dynamic and multifunctional and has contribution in maintaining climatic and ecological balance in the Indian Subcontinent with their forests areas and watersheds. The research work was conducted in four major Eastern Himalayan forest areas in India (Neora Valley National Park, Senchal Wildlife Sanctuary, Gorumara National Park and Buxa Tiger Reserve). Supporting services, provisioning services and cultural services of the ecosystems were studied in the forest areas and forest edge hamlets. Utilization of the water resources (rivers and springs), traditional methods of rainwater harvesting, collection and utilization of non-timber forest produce (NTFP), joint forest management, agricultural diversity and agroforestry, application of nutrient rich forest soil in agriculture, medicinal plant utilization by the local communities and ecotourism potential are some of the perspectives studied for analysing the ecosystem services of the forest areas. The possible threats to the ecosystem services are documented during the study. Photographs were taken, analysed and interpreted in light of the survey data collected from the area. There is an urgent need for implementing an integrated sustainable development system for the conservation and improvement of ecosystem services in the eastern Himalayan forest areas.

2b: From traits to ecosystem processes via remote sensing

Conveners: Gerlinde de Deyn (Wageningen University & Research)
Lammert Kooistra (Wageningen University & Research)
Peter van Bodegom (Leiden University)

1. Scaling from plant traits to ecosystem processes via remote sensing

Gerlinde De Deyn, Peter van Bodegom, Lammert Kooistra
Wageningen University & Research

Plants play a critical role in maintaining the equilibrium in the biosphere. Therefore, different scientific disciplines are looking for effective methods to characterize plant functioning in both agricultural and natural ecosystems. Trait-based ecology has proven an important step in making vegetation ecology a more predictive science. However, quantifying traits at field/landscape level is time consuming, costly and the temporal dynamics is often missing. Remote sensing based methods allow innovative possibilities to assess traits at detailed spatio-temporal scale, allowing improved coupling of plant traits to ecosystem functioning. With the advance of imaging spectroscopy, high-resolution spectral observations and the availability of multispectral data from e.g. the Sentinels, biochemical and structural traits can be quantified. Regular monitoring results in a time-series of observations which gives insight in functional biodiversity patterns and balances and fluxes of water and nutrients within ecosystems. In combination with ecosystem models this allows for increased detail and understanding of spatial-temporal processes. In this presentation, an overview will be given how remote sensing can be adopted to link plant traits to ecosystem processes across spatial and temporal scales. We will specifically focus on the added value of new sensing capabilities and associated analysis methods to characterize plant functional traits. This will be illustrated in case studies examples.

2. Remote sensing for quantifying plant traits at ITC, University of Twente

Roshanak Darvishzadeh, Andrew Skidmore, Tiejun Wang, Thomas Groen
University of Twente

Understanding and monitoring terrestrial ecosystems requires quantifying ecosystem structure, ecosystem function and plant species traits. Many of these traits are inputs to agricultural, ecological, and meteorological models and several have been recognized as essential biodiversity variables by GEO BON. These include leaf area index (LAI), chlorophyll, specific leaf area (SLA), water content, nitrogen, vegetation height, cover, layering and gaps. Field measurement of these traits is labour-intensive, costly, and only practical for limited samples. Remote sensing has been recognized as a reliable method for mapping and monitoring vegetation and the only practical means of estimating these traits in a large scale. However, utilizing remote sensing, not only requires understanding the link between these traits and plant's spectral signature but also how these traits interact and how the combined interaction will affect the spectral signature of vegetation. The natural resources department (NRS) of the Faculty ITC is leading in the innovative applications of wide range of remote sensing data (including new generation of multi spectral, VIS/NIR/thermal hyperspectral, and LIDAR) and models including empirical and radiative transfer models to quantify, map and monitor plant traits. Client traits have been successfully retrieved at the laboratory, field, airborne and satellite levels. We have examined the retrieval of plant traits in different ecosystems including rangelands, crop lands, wetlands and forest at leaf and at canopy level. Many of these traits were estimated using spectral information obtained from narrow wavelengths existing in hyperspectral data in the VIS/NIR regions. Our investigations, through the work of number of PhD's, have successfully utilized thermal hyperspectral and LiDAR measurements to map and quantify these plant traits at leaf and canopy levels.

3. Dunes from above: Relating patterns to dune building processes

Marinka van Puijenbroek, Corjan Nolet, Juha Suomalainen, Frank Berendse, Juul Limpens
Wageningen University & Research

Natural development of new coastal dunes increase nature-based shoreline protection and enhances biodiversity, but little is known about the early phases of dune development. Dune development is a result of the feedback between vegetation and sand deposition. It is unclear how morphological plant traits (density and height) and dune size influence the biophysical feedback. We explored the biophysical feedback on dune development in a dune field of 8 hectares using 3D image analysis. We monitored changes in dune volume and vegetation of a natural embryonic dune field over 1 year, using a drone with a camera. The area comprised dunes with both pure and mixed vegetation of dune building grasses *Ammophila arenaria* and *Elytrigia juncea* at equal distance to the sea. We found significant relationships between morphological plant traits and dune volume, with embryo dune volume peaking for dunes having a mix in plant traits. Changes in dune volume over summer were associated with dune size, displaying size-dependent feedback with big dunes growing faster than small dunes. Our results give evidence for relationships between plant traits, size dependency and biophysical feedback in dune building.

4. Predicting fire behaviour (in-)directly via plant traits and Remote Sensing

Luke Blauw, Richard van Logtestijn, Harm Bartholomeus, Lammert Kooistra, Hans Cornelissen, Rien Aerts
Vrije Universiteit Amsterdam

Wildfires have been thoroughly investigated over the past decades and its drivers are well known. That knowledge is important to accurately define carbon emission models and conduct efficient fire management. Although both of these operate on a large scale, most fire research is based on small-scale laboratory experiments and occasionally large-scale field experiments. Yet, satellite RS images are already used to determine global and local fire frequencies, but satellites have a low spatial resolution and cannot be used in fire management. Therefore, airborne RS is used to accurately estimate plant traits and vegetation indices and that could be used to determine plant flammability traits. Accurate RS estimates of flammability traits could provide indirect predictions of fire behaviour. In dry and fire-prone areas, airborne RS could measure plant traits and estimate its sensitivity to fire and associated fire behaviour. We carried out 12 prescribed fires in young and old Scottish heathland, similar to Dutch heathlands, to determine the relation between plant traits, fire behaviour and remote sensing. Our results indicate a strong effect of plant traits on fire behaviour and that fire behaviour could be estimated based on the RS images.

5. Monitoring vegetation height and greenness of low floodplain vegetation with a UAV

Wimala van Iersel, Menno Straatsma, Elisabeth Addink, Hans Middelkoop
Utrecht University

Vegetation in river floodplains has an important function for biodiversity with implications for flood safety. Because of river restoration projects, floodplain vegetation is becoming increasingly heterogeneous. This requires a more sophisticated monitoring of floodplain vegetation. Mapping of floodplain vegetation is often based on remote-sensing data from a single time step, which limits monitoring of seasonal changes. Plant height and greenness of pioneer, grassland and herbaceous vegetation types are highly dynamic in space and time, especially under pressures like mowing and grazing. Seasonal survey frequencies are required to monitor their functioning. The rising availability of unmanned airborne vehicles (UAV) has a high potential to increase monitoring frequency. This study evaluated the potential of monitoring the traits vegetation height and greenness over one growing season with a UAV. Vegetation height was measured six times during one year in 28 field plots within a 100 ha floodplain. Simultaneously with each field survey we recorded UAV imagery, from which vegetation height and greenness were estimated. The main conclusions were that: (1) vegetation height is estimated most accurately during leaf-on conditions (RMSE = 0.17-0.22 m), and (2) the different low vegetation types show different hysteresis in temporal relations between vegetation height and greenness, which can facilitate classification of these classes.

6. Detecting soil microbial community shifts via remote sensing

Gera Hol, Harm Bartholomeus
Netherlands Institute of Ecology

Reliable information on plant and soil health is important for early detection and prevention of pests, diseases or abiotic stresses. While diseases in agricultural systems can often be reliably assessed via remote sensing, it is unknown to what extent subtler changes in soil biodiversity could be detected. Plants have a multitude of positive and negative interactions with soil microorganisms which can all affect plant quality. Therefore, it seems plausible to detect shifts in soil microbial communities remotely by measuring plants, on the leaf or even above. We tested the hypotheses that 1) plants growing with different microbial communities will vary in leaf hyperspectral reflectance, and 2) the spectra from plant communities can be used to derive microbial communities. We measured hyperspectral reflectance patterns of *Achillea millefolium* and *Trifolium repens* leaves, as well as the whole mixed plant community with 7 plant species, growing on sterilized soils inoculated with field soil. Microbial communities varied in composition caused by serial dilution, resulting in decreasing bacterial diversity. Largest differences in the leaf vegetation indices were found between the most diverse soils and the non-inoculated control soils. The community level measurements showed stronger treatment signals than the leaf measurements. We will discuss the potential and constraints for detecting changes in microbial communities via plant hyperspectral reflectance.

2c: **THIS SESSION WAS UNFORTUNATELY CANCELLED**

2d: Carbon cycling in terrestrial, wetland and aquatic ecosystems: from plot to global scale

Conveners: Nadia Soudzilovskaia (Leiden University)
Ciska Veen (Netherlands Institute of Ecology)

1. Carbon cycling in terrestrial, wetland and aquatic ecosystems: from plot to global scale

Tom Crowther
Netherlands Institute of Ecology

The majority of the Earth's terrestrial carbon is stored in the soil. If anthropogenic warming stimulates the loss of this carbon to the atmosphere, it could drive further planetary warming. Despite evidence that warming enhances carbon fluxes to and from the soil the net global balance between these responses remains uncertain. Here we present a comprehensive analysis of warming-induced changes in soil carbon stocks by assembling data from 49 field experiments located across North America, Europe and Asia. We find that the effects of warming are contingent on the size of the initial soil carbon stock, with considerable losses occurring in high-latitude areas. By extrapolating this empirical relationship to the global scale, we reveal that global soil carbon stocks in the upper soil horizons will fall by, on average, 55 petagrams by 2050. This value is around 12–17 per cent of the expected anthropogenic emissions over this period. This provides strong empirical support for the idea that rising temperatures will stimulate the net loss of soil carbon to the atmosphere, driving a positive land carbon–climate feedback that could accelerate climate change.

2. Effect of warming on freshwater carbon cycling in macrophyte dominated systems

Mandy Velthuis, Sarian Kosten, Ralf Aben, Garabet Kazanjian, Sabine Hilt, Edwin Peeters, Ellen van Donk, Liesbeth Bakker
Netherlands Institute of Ecology

Global warming is increasingly affecting aquatic ecosystems. Since the 1960s, temperatures have been rising at a rapid pace and are predicted to increase further over the coming century. Knowledge on how warming affects different components of the freshwater carbon cycle is essential to understand the carbon storage potential of freshwaters in the near future. Here, we investigated the impact of warming on carbon sequestration by a freshwater macrophyte, sedimentation rates of particulate carbon and decomposition of macrophyte leaf material. Our study species was *Myriophyllum spicatum*, a submerged macrophyte common in Europe. We performed an indoor mesocosm experiment using 1000 l mesocosms testing two temperature scenarios: a temperate seasonal temperature pattern, and a warmed (+4°C) scenario. During a full experimental year, plant phenology and biomass, sedimentation rates and decomposition rates were measured. In the warmed treatment, overall plant volume infested was higher throughout the entire experimental year. Associated with this higher biomass, sedimentation rates were also elevated in the warm treatment. Furthermore, macrophyte leafs were decomposed to a larger extent in the warm treatment. Combined, these data show that warming has strong effects on several components of freshwater carbon cycling, while the net effect of warming can be near neutral.

3. The role of native and range-expanding plant communities in buffering the effects of drought on soil functioning

Marta Manrubia-Freixa, Kelly Ramirez, Stefan Geisen, Carolin Weser, Freddy ten Hooven, Ciska Veen, Wim van der Putten
Netherlands Institute of Ecology

Climate change is altering the composition of plant communities at high altitudes and latitudes by enhanced extreme events, range shifts and de-coupling of co-evolved trophic interactions. Previous research has shown that invasive plant species and abiotic stressors can change carbon and nutrient cycling at local scales. However, it remains unclear whether novel communities formed by range-expanding plant species also alter soil functions in the new ranges and what roles enhanced incidence of drought stress play in these novel communities. We tested the hypothesis that plant species that shift range from southern to northern Europe have greater resistance and resilience under extreme drought events, especially in the presence of southern soil communities. Plant communities of range-expanding and related native species were planted in a multi-year mesocosm experiment outside. In 2016, we applied a 6-week summer drought to half of the mesocosms. Soil samples were collected before, during and after drought. We measured the functioning of soil communities (e.g. litter decomposition, carbon mineralization and soil enzymatic activities) to quantify their resistance and resilience to drought stress. Our results assess the interactions of plant range-expansion and drought stress on key ecosystem processes. Results will be presented and we will discuss how effects of climate change may interact with effects of range shifts.

4. Grass root abundance, not plant species richness, decreases fine root decomposition in an experimental grassland

Natalie Oram, Hongmei Chen, Alexandra Weigelt, Jasper van Ruijven
Wageningen University & Research

Plant diversity (SR) and functional group composition can alter decomposition of plant-derived litter. Less is known about how plant community composition influences root decomposition in grasslands, even though most plant biomass is belowground. Factors that influence root decomposition likely implicate carbon cycling. In the Jena Trait Based Experiment, we used a litterbag experiment to measure mass-loss of native (home) and a standard root litter to test the effects of SR, litter-mixing effects, and belowground functional group composition (grass root abundance, GRA, based on species-specific root biomass determined with RT-qPCR) on root decomposition, via litter quality and the soil environment. We then tested if root chemical and morphological traits could explain these effects on root decomposition. We found no relation between SR and mass-loss. Instead, GRA was negatively related to native root mass-loss, and positively related to standard root mass-loss. Increasing GRA also lead to positive litter mixing effects. Root diameter was positively related to native mass-loss and explained unique variation, apart from that explained by GRA. Root chemical traits, carbon and nitrogen content and C:N ratio, were poorer predictors of native root mass-loss. We conclude that belowground functional group composition and root diameter can aid in explaining root decomposition in grasslands.

5. The role of phytoplankton productivity on the atmospheric CO2 flux of a eutrophic lake

Jolanda Verspagen, Maria Meijer, Arie Vonk, Josh Dean, Jef Huisman
University of Amsterdam

Lakes play an important role in the global carbon cycle because they receive large amounts of terrestrial organic carbon, which is mineralized within the lake, buried in the sediment or transported downstream. The mineralization of terrestrial carbon results in CO_2 supersaturation in many lakes, turning these lakes in sources of CO_2 to the atmosphere. Eutrophic lakes however, can sustain dense phytoplankton blooms with a high primary productivity and a large demand for inorganic carbon. Productive lakes may therefore act as sinks of atmospheric CO_2. To find out how phytoplankton productivity influences the atmospheric CO_2 flux, we carried out continuous measurements of dissolved CO_2, chlorophyll fluorescence and the atmospheric CO_2 flux, in a shallow, eutrophic peat lake (Amstelveense Poel). The lake was dominated by a dense phytoplankton bloom from early June to early November that continuously depleted dissolved CO_2 concentrations, confirming that productive lakes can act as sinks of atmospheric CO_2.

6. Global patterns in above- and belowground ecosystem properties across montane grassland – forest ecotones

Jordan Mayor, David Wardle, Ellen Cieraad, Nathan Sanders, Aimee Classen, Richard Bardgett, Jean-Christophe Clement, Alex Fajardo, Sandra Lavorel, Maja Sundqvist, Michael Bahn, Chelsea Chisholm, Ze'ev Gedalof, Karl Grigulis, Gaku Kudo, Daniel Oberski
Leiden University

Temperature plays a key role in the distribution of biodiversity and ecosystem boundaries. In mountainous areas, elevational gradients with associated declining temperature gradients shape plant community composition, metabolic processes and ecosystem dynamics. Elevational gradients also enable the prediction of long-term ecological responses to climate warming. The treeline ecotone, with its striking abrupt transition from forest to treeless alpine ecosystems, presents an intriguing testing ground to disentangle the effects of temperature on ecosystem properties, including carbon cycling. We tested whether there are globally consistent above- and belowground responses to these transitions, across treeline ecotones in seven temperate regions of the world. We found that declining temperatures with elevation resulted in a stoichiometric convergence of ground layer plant community nitrogen to phosphorus ratio across all regions. The indirect effects of temperature on tree cover strongly mediated soil organic matter, carbon to nitrogen ratio, and microbial biomass and respiration. Our study indicates that future warming may disrupt the synchrony of ecosystem properties in montane systems. This is especially important if the reorganisation of plant communities will outpace treeline advance.

2e: Predicting evolution: state-of-the-art and novel interdisciplinary approaches

Conveners: Marcel Visser (Netherlands Institute of Ecology)
Jacintha Ellers (Vrije Universiteit Amsterdam)

1. Predicting Evolution: One of the game changers in the new Origins Center

Marcel Visser, Jacintha Ellers
Netherlands Institute of Ecology

The evolution of life is the hallmark of the natural sciences. Understanding how life has evolved, and is still evolving, in interaction with the environment has been at the forefront of science ever since Darwin. Evolutionary knowledge is also a powerful tool outside the biological sciences, used in evolutionary medicine to understand disease, and in artificial intelligence to design self-organising life. The 'next big step' is to make the transition from understanding evolutionary trajectories to predicting them. This has been formulated as one of the five 'game-changers' of the recently founded Origins Center. This Center aims to answer a number of questions of the Dutch Science Agenda via interdisciplinary research. To predict evolution we need a better understanding of evolutionary mechanisms, such as non-genetic forms of inheritance, genomic networks and the dynamic feedback between organisms and their environments. A second requirement is insight in external conditions that determine the rate of changes on our planet, such as the current anthropogenic changes, as it is this environment which will determine the selection to which evolution can respond to. In this symposium we want to explore where we stand with predicting evolution, and which route to take to reach this game-changer.

2. Organics on Mars

Ingeloes ten Kate
Utrecht University

Upcoming and future missions will look for organics on Mars as possible biomarkers for evolution of life. Ongoing investigations at Mars on board the Curiosity rover have led to the first detection of Martian organics in the Cumberland samples as well as hinted towards the presence of organic compounds in several other analysed soil samples. Even though these results are at least partly skewed by the presence of organic contaminants and Mars-indigenous calcium perchlorates, the Martian origin is no longer doubted. Organics on Mars can be binned into two categories: indigenously produced and exogenously delivered. In this presentation I will focus on exogenously delivered organics and the different alteration processes at work on the Martian surface. These processes include degradation by ultraviolet radiation and oxidation through different pathways . I will give an overview of the type of organics that are delivered, as well as an indication of the organics that can be anticipated after alteration. I will conclude by briefly addressing the broader context of scientific questions about organics on Mars and the Early Earth.

3. Breaking through evolutionary constraint by variable environments

Marjon de Vos, Alexandre Dawid, Vanda Sunderlikova and Sander Tans
Wageningen University & Research

Evolution is constrained when mutational trajectories are trapped at suboptimal fitness peaks on the adaptive landscape, thereby causing evolutionary stasis. We show that these constraints can be overcome in an adaptive manner in variable environments. Cross-environmental trade-offs, typically associated with evolutionary limitations, are an essential enabling component of this evolutionary mechanism. Our results underscore the importance of characterizing environmental dependencies of evolution and provide the clearest indication so far that environmental variability can accelerate evolution. Given that environmental variations and trade-offs are ubiquitous, this evolutionary mechanism may be relevant to a wide range of genetically constrained phenotypes and major evolutionary transitions.

4. Evolution of range expanding plants

Mirka Macel
Radboud University Nijmegen

Due to climate change, some species are shifting their distribution ranges towards the poles. What happens with these species in their novel range? Do they quickly evolve and adapt to their new biotic and abiotic environments? Can we predict evolutionary changes in the novel range? We tested the genetic and phenotypic differentiation and regional adaptation of the range expanding plant *Rorippa austriaca*. This species is native to central-east Europe and has expanded its range to West and Northern Europe. Molecular genetic analyses showed that the genotypes from the novel range in Western Europe were different from native genotypes. Plants from higher latitudes in the novel range showed increased vigour, faster clonal growth and subtle differences in chemical defences and herbivore resistance. A transplant field experiment showed that the increased vigour was independent from environmental factors. Herbivory was higher at the sites in new range compared to the native range, and genotypes from the new range were less damaged by herbivores. Our results suggest that

range expanding plants may evolve increased vigour and altered herbivore resistance in their novel range, analogous to evolution of invasive plants. Theories on the evolution of invasive species could therefore be used to predict the evolution of species that are on the move due to global warming.

5. Explaining the apparent lack of micro-evolution in natural populations

Phillip Gienapp, Jip Ramaker, Marcel Visser
Netherlands Institute of Ecology

Micro-evolution in quantitative traits, i.e. traits that show continuous variation, as e.g. morphology, many behaviours or life-history traits, can be predicted following the simple 'Breeders' equation', which states that the evolutionary change from one generation to the next is the product of the selection on, and heritability of, the trait. Predictions from the Breeders' equation did, however, often fail to match observed phenotypic change in natural populations. A number of explanations, as e.g. inflated heritabilities, constraints through genetically correlated traits, having identified the wrong 'target' of selection, or fluctuating selection, have been proposed to explain this apparent lack of micro-evolution in traits under selection. Advanced quantitative genetic models in combination with high quality data allow us to tackle the question why predictions and observations of evolutionary change in natural populations often do not match. Using data from two study populations of great tits that have been closely monitored for decades, we tested several of the above mentioned explanations and by carefully analysing our data that predicting micro-evolution in natural populations can be possible.

6. Unravelling processes behind local adaptation: experimental evolution with spider mites

Karen Bisschop, Adriana Vallejo Alzate, Frederik Mortier, Rampal Etienne, Dries Bonte
University of Groningen / Ghent University

Ecology can interact with evolution at the same time scale. This implies that ecological forecast needs to consider evolutionary dynamics as a potentially important steering component. These evolutionary processes are anticipated to be especially important during invasions of novel environments. Experimental evolution in mesocosms can provide better insight in the relative contribution of ecology and evolution underlying population dynamics. Novel environments are typically spatially heterogeneous and occupied by other species. We therefore tested how spatial heterogeneity, combined with the presence of a competing species affects the rate of ecological specialization in the spider mite *Tetranychus urticae*, adapting to novel host plants. We demonstrate that intraspecific competition strongly constrains the process of local adaptation. In addition, intermediate levels of dispersal are shown to be beneficial for adaptation. When competition is strong, higher connectivity facilitated local adaptation. Because eco-evolutionary dynamics are difficult to study in real landscapes, we advocate the further development of mesocosm experiments to test the interplay of changes in spatial configuration, environmental change and biotic interactions on the evolution of ecological specialization.

Parallel Session 3

3a: Plant-community interactions

Conveners: Rocío Escobar-Bravo (Leiden University)
Saioa Legarrea (University of Amsterdam)

1. Can beneficial microbes help mitigate plant growth-defence trade-offs under shading?

Arjen Biere, Sjoerd Engelbertink
Netherlands Institute of Ecology

Plants respond to the presence of competitors by activating the so-called Shade Avoidance Syndrome, characterized e.g. by elongation growth and narrowing of the leaf angle. This response, initiated by the perception of neighbours through photoreceptors, enables plants to maintain or regain their position in the vegetation canopy. However, this response is generally traded off with the plant's ability to defend itself against necrotrophic pathogens and generalist chewing herbivores. We investigated whether arbuscular mycorrhizal (AM) fungi can help mitigate such trade-offs under shading conditions in the perennial plant ribwort plantain (*Plantago lanceolata*). These fungi are known to enhance growth as well as defence in a number of systems. We simulated the presence of neighbours by lowering the red-to-far-red ratio, a cue used by plants to activate the shade avoidance syndrome, and tested whether plants can better maintain resistance against a necrotrophic pathogen and a chewing insect herbivore in the presence of AM fungi than in their absence. The results do not strongly support the hypothesis and show that effects are dependent on both plant age and mycorrhizal strain.

2. Contrasting responses of insect communities to grazing intensity in lowland heathlands

Michiel Wallis de Vries
Wageningen University & Research

Grazing at low stocking rates is often recommended for the preservation of the characteristic biodiversity of open landscapes. However, the fine-tuning of grazing management still lacks a good evidence base. This is particularly true for insect communities, as available evidence indicates that these are more vulnerable to grazing than plant communities. The outcome, however, may be expected to differ between insect species. Here, I focus on the impact of different grazing intensities on insect communities lowland heathlands in the Netherlands. Species responses to grazing intensity were investigated across a range of insect groups (butterflies, day-active moths, grasshoppers, and ants) on 16 field from livestock-grazed and ungrazed locations. We hypothesized that species from early successional stages would benefit from grazing whereas late-successional species would suffer from grazing. Species responses to grazing indeed contrasted between early and late successional species. Variation in species responses were strongly linked to grazing intensity and soil moisture, reflecting species-specific niches in relation to vegetation structure and microclimate. I compare these findings with the results from a study on wild herbivore impacts.

3. How a specialist herbivore and competition affect the performance of invasive ragweed in Europe

Suzanne Lommen, Caspar Hallmann, Eelke Jongejans, Benno Augustinus, Urs Schaffner, Heinz Müller-Schärer
University of Fribourg

The North American common ragweed, *Ambrosia artemisiifolia*, is an invasive plant which is established in large parts of Europe. Freed from its specialist natural enemies, it performs well when plant competition is low, resulting in adverse effects on human health and crop production. We here aimed to examine how the recent accidental introduction of a specialist herbivore from its native range, the leaf beetle *Ophraella communa*, affects the performance of ragweed, and how this interacts with plant competition. During 3 years, we experimentally manipulated the presence of the beetle in natural populations of ragweed south of the Alps that were colonized by the beetle and vary in vegetation cover. We first assessed the impact of the beetle, plant competition and potential interactions on life-history traits of individual plants. We found large spatiotemporal variation in the effects, and discuss which environmental factors may underlie this. Using these data in stochastic demographical models, we then project how this variation affects the long-term population dynamics of ragweed. We discuss the implications of these results for the potential of using this beetle for the biological control of ragweed.

4. Omnivorous predator affects performance of herbivores through induced plant defences

Xiaoning Zhang, Gerben Messelink, Juan Alba, Arne Janssen
University of Amsterdam

Plants possess various defence mechanisms that result in synthesis of secondary metabolites in response to herbivory. These defences are known to interfere with the performance of herbivores of the same and other species. Much less is known of the effects of plant feeding by omnivores. We found that previous exposure of plants to the omnivorous predator *Macrolophus pygmaeus* significantly

reduced the reproduction rate of several herbivore species on the same plants. Defence-related plant hormones were accumulated after phytophagy by *M. pygmaeus*. Our results suggest that omnivorous predators are able to decrease the performance of herbivores through induced plant defences.

5. **Predicting soil legacy effects on plant communities and their herbivores**
Robin Heinen, Martijn van der Sluijs, Arjen Biere, Jeffrey Harvey, Martijn Bezemer
Netherlands Institute of Ecology

Plant communities and soil biota critically depend on each other for their existence. Plants can influence local soil life and soil communities change their composition in response to the plants growing in the soil. In turn, these specific soil communities can have strong effects on plants that grow later in the same soil (i.e. soil legacy effects), but effects can even go further up the food chain, to insect herbivores. Soil legacy effects on plants vary in size and direction. An important question is whether the outcome can be predicted, for example by plant traits. Further, it is important to test if soil legacy effects also operate under more natural conditions. In this study, we took a trait-based approach in order to test whether functional group and root size of the conditioning species could predict the outcome of soil legacy effects on plant communities and insect herbivores feeding on the communities aboveground. Our results show that in a community context, functional group, but not root size of the conditioning plant species may play a role in aboveground plant-insect interactions.

6. **Mutualistic interactions mitigate impacts of drought and grazing on salt marsh vegetation**
Marlous Derksen-Hooijberg, Jasper Hoogveld, Leon Lamers, Annieke Borst, Alfons Smolders, Christine Angelini, Tjisse van der Heide
Radboud University Nijmegen

In US salt marshes, smooth cordgrass (*Spartina alterniflora*) provides essential ecosystem services such as shoreline protection, biodiversity enhancement and carbon sequestration. In recent decades however, salt marshes have suffered large-scale sudden vegetation dieback, presumably related to anthropogenic climatic changes such as increased periods of repetitive drought. Furthermore, the grazing activities of high densities of marsh snails (*Littoraria irrorata*) have also been demonstrated to cause vegetation dieback in these marshes, and the combination of these stressors appears to have synergistic impacts. On the other hand, recent research showed that a common mutualism in these marshes between cordgrass and ribbed mussels (*Geukensia demissa*) is able to strongly enhance marsh resilience and recovery rates. However, if, how, and to what extent the mutualism can buffer combined stressors of snail grazing and climatic changes (repetitive drought and warming) is not well understood. In a field experiment we therefore investigated how cordgrass responds to these stressors separately and combined, both in the presence and absence of mussels.

3b: The host-microbiome: the unseen organ

Conveners: Silvia Cretoiu (University of Amsterdam)
Henk Bolhuis (Royal Netherlands Institute for Sea Research)

1. Symbiosis revisited: *Sphagnum* vs. its microbiome - Environmental controls on N_2 fixation and *Sphagnum* performance in peatlands

Eva van den Elzen, Martine Kox, Sarah Harpenslager, Geert Hensgens, Christian Fritz, Mike Jetten, Katharina Ettwig, Leon Lamers
Radboud University Nijmegen

In pristine *Sphagnum* dominated peatlands, (di)nitrogen (N_2) fixing (diazotrophic) microbial communities associated with *Sphagnum* mosses contribute substantially to the total nitrogen input, increasing carbon sequestration. The rates of symbiotic nitrogen fixation reported for *Sphagnum* peatlands, are, however, highly variable and experimental work on regulating factors that can mechanistically explain this variation is largely lacking. We studied the effects of the availability of the most important nutrients, nitrogen and phosphorus and the acid buffering capacity of the surrounding water on both *Sphagnum* performance and nitrogen fixation activity of its microorganisms. In view of a mutualistic interaction between host and microbiome we expected phosphorus to have a stimulating effect on both *Sphagnum* growth and nitrogen fixation activity and acid buffering to negatively affect both partners. However, surprisingly, a totally different image arose from the results from our lab and field experiments, suggesting a less beneficial interaction for both partners than expected. Moreover, *Sphagnum* does not seem to directly profit from its diazotrophic microorganisms, which in turn points at a trade-off between less favourable environmental conditions and the sheltered environment of the *Sphagnum* tissue.

2. Animal-microbiota dynamics vary across levels of biological organisation in wild birds

Pieter van Veelen, Joana Falcao Salles, Irene Tieleman
University of Groningen

Animal-microbe symbioses are ubiquitous and play a central role in animal ecology and evolution. Animals acquire symbiotic microbial partners via vertical and horizontal transmission processes, but the driving mechanisms and their relative importance are currently topic of active discussion. For most animal taxa, our knowledge of variation of symbiotic microbial communities at different levels of biological organisation is limited or lacking. Consequently, our understanding of the assembly processes that govern microbial colonisation of animals is vital to our ability to comprehend animal-microbiota dynamics, and the role that symbionts play in animal ecology and evolution. We studied bacterial microbiota patterns of wild birds, at different levels of biological organisation, in relation to bacterial communities in their immediate surroundings. Our data show that the structure and composition of bacterial communities vary between species, between individuals and between different microbial habitats of the body; differential patterns across levels of biological organization. Moreover, the degree of community resemblance within levels of biological organisation provides indirect insights into the relative importance of ecological community assembly processes in shaping animal microbiota. Our results highlight the potential of metacommunity theory to building a general framework on the ecology and evolution of animal-microbiota.

3. The role of the belowground plant microbiome in climate change induced range shifts

Kelly Ramirez, Basten Snoek, Janneke Bloem, Wim van der Putten
Netherlands Institute of Ecology

With climate change, plants have been able to shift their ranges into novel environments were conditions have been made suitable due to warming temperature and changes in precipitation. Much belowground range expansion research has focused on either positive plant-soil interactions, such as AMF symbiosis, or on negative plant-soil interactions, such as pathogens. Less focus has been given to the core microbiome of plant hosts. Using high-throughput Illumina sequencing we assessed soil and root microbial communities under native and range expanding plant species spanning a north-south latitudinal transect in central Europe. As expected, the soil and root microbiomes are both strongly influenced by the plant species under which they grow. Specifically, about 10% of the microbiome could be related to the host plant species. Interestingly, we found that microbiomes associated with range shifting species are less variable than those associated with native species. Further, the enrichment of microbes in roots (from the soil) is stronger with range expanding species than with native plant species. Our research indicates that the soil and root microbiomes can provide insight into plant range shifts and may be important for plant establishment.

4. The persistent association of denitrifying Rhizobiales endophytes with *Azolla*: foul-play in the leaf pocket?

Laura Dijkhuizen, Paul Brouwer, Henk Bolhuis, Gert-Jan Reichart, Nils Koppers, Bruno Huettel, Fay-Wei Li, Shifeng Cheng, Xin Liu, Gane Ka-Shu Wong, Kathleen Pryer, Andreas Weber, Andrea Bräutigam, Henriette Schluepmann
Utrecht University

Dinitrogen fixation by *Nostoc azollae* residing in specialized leaf pockets supports prolific growth of the floating fern *Azolla filiculoides*. To evaluate contributions by further microorganisms, the *A. filiculoides* microbiome and nitrogen metabolism in bacteria persistently associated with *Azolla* ferns were characterized. A metagenomic approach was taken complemented by nitrogen isotope determinations of fern biomass and detection of N_2O released. Ribosomal RNA genes in sequenced DNA of natural ferns, their enriched leaf pockets and water filtrate from the surrounding ditch established that the *A. filiculoides* microbiome differed entirely from surrounding water and revealed species of the order Rhizobiales. Analyses of seven cultivated *Azolla* species confirmed persistent association with Rhizobiales. Two distinct near full-length Rhizobiales genomes were recruited from leaf-pocket enriched samples of ditch grown *A. filiculoides*. Annotation revealed genes for denitrification but not N_2 fixation. $^{15}N_2$ incorporation was active in ferns with *N. azollae* but not in ferns without. N_2O was not detectably released from surface sterilized ferns with the Rhizobiales. N_2-fixing *N. azollae*, we conclude, dominate the microbiome of *Azolla* ferns. The persistent but less abundant heterotrophic Rhizobiales bacteria possibly contribute to lowering O_2 levels in leaf pockets but did not release detectable amounts of the strong greenhouse gas N_2O.

5. Microbiome analysis of the soil immune response

Irene de Bruijn, Ruth Gómez Expósito, Joeke Postma, Jos Raaijmakers
Netherlands Institute of Ecology

The impact of microbiota on health, growth and development of their eukaryotic hosts (human, animal, plant, insect) is gaining considerable attention. Here, we investigated the temporal dynamics in taxonomic and functional diversity of the plant microbiome in natural disease suppressive soils. In disease suppressive soils, soil-borne plant pathogens cause little or no disease due to microbial activities in the soil or plant rhizosphere. Disease suppressiveness to soil-borne fungal pathogens is typically induced in soils during repeated exposure of the susceptible plants to the virulent pathogen, a phenomenon that strongly resembles the adaptive immune response in animals. For most disease suppressive soils, however, the microbial communities and mechanisms involved in the induction of disease suppression remain largely unknown. In this study, we induced disease suppressiveness in soils against the fungal root pathogen *Rhizoctonia solani* by growing the host plant (sugar beet) successively in presence of the pathogen. We studied the dynamics of the microbial communities as well as in situ gene expression during the transition of the soil from a disease conducive to a disease suppressive state. Taxonomic analyses revealed only minor changes in the rhizobacterial community composition whereas metatranscriptome analysis showed substantial changes in the expression of specific functions during the induction of disease suppressiveness. These results indicate that disease suppressiveness is more likely due to changes in the activity of specific members of the microbial communities rather than to substantial changes in the microbial community composition. This study further highlights that a combination of multiple 'omics techniques provides better insight into the impact of microbiota on their host.

6. Population-level profiling and analysis of the human microbiome

Leo Lahti
University of Turku

Microbial communities inhabit the human body with a profound impact on our physiology and well-being. Whereas the composition and function of these diverse microbial ecosystems have been studied extensively, we have only a limited understanding of their individuality and temporal dynamics. The available longitudinal time series remain limited to relatively small numbers of individuals or time points. Together with the remarkable variation that has been reported within and across individuals this sets challenges for analysis. Establishing links between community composition, dynamics, and environment presents a fundamental challenge for host-microbiome studies. Recent accumulation of high-throughput profiling data is now enabling population-level studies across thousands of human individuals with a deep phylogenetic resolution. Scaling up the current analyses by an order of magnitude helps to uncover universal population-level variation that extend beyond individual dynamics. I will discuss our analysis methods and recent key observations on microbiome variation across large population cohorts based on ongoing collaboration with Prof Jeroen Raes (VIB/KU Leuven, Belgium) and Prof Willem M de Vos (Wageningen University & Research, The Netherlands), with implications for the design and interpretation of future studies.

3c: Establishment ecology

Conveners: Zhenchang Zhu (Royal Netherlands Institute for Sea Research)
Tjisse van der Heide (Radboud University Nijmegen)
Tjeerd Bouma (Royal Netherlands Institute for Sea Research)

1. Establishment problems of foundation species: knowledge from coastal wetlands

Zhenchang Zhu, Tjisse van der Heide, Tjeerd Bouma
Royal Netherlands Institute for Sea Research

The establishment of foundation species is a vital step for community development and ecosystem restoration, yet the pioneer establishment in hostile environment often proves to be difficult due to bottlenecks and thresholds imposed by environmental stressors. Using seedling establishment of coastal foundation plants as an example, we show how establishment success in stressful coastal wetlands can be shaped by multiple bottlenecks as well as the consequences for long-term ecosystem persistence in the face of climate change induced environmental changes. This talk will end with an overview of the presentations included in this session.

2. Biophysical interactions close the Window of Opportunity for tidal marsh establishment

Jim van Belzen, Zhenchang Zhu, Peter Herman, Johan van de Koppel, Tjeerd Bouma
Royal Netherlands Institute for Sea Research

There is longstanding recognition that periods of favourable conditions - so called 'Windows of Opportunity' (WoO)- are key for the initial establishment and recovery of many stressful ecosystem. WoO are often explained in terms of a reduction in either physical or biological stressors due to seasonal and random variability. Yet, little attention has been paid to the role of interactions between physical and biological factors. Here, we reveal with a series of field and laboratory experiments the importance of biophysical interactions for the establishment of vegetation on tidal flats. They demonstrate that the presence of sediment dwelling animals can boost the response to physical forcing by waves and tidal action, thereby closing the WoO for vegetation establishment on tidal flats. Our results underline the importance of interactions via modifications of the habitat (i.e. ecosystem engineering). Because such interactions strongly depend on environmental conditions, they are likely to play an important role in determining the responses of plant establishment to climate change and alter the trajectories of restoration scenarios in tidal marshes and other stressful ecosystems.

3. Food or furniture – a study of an epiphyte and its invertebrate community

Annieke Borst, Christine Angelini, Anne ten Berge, Marlous Derksen, Leon Lamers, Tjisse van der Heide
Radboud University Nijmegen

Presentation abstract. Both habitat complexity created by foundation species and food web interactions are considered as important drivers of biodiversity. However little is known to what extent community structures in systems shaped by foundation species can be explained by food web interactions. *Tillandsia usneoides* or Spanish moss is a rootless epiphyte from the southern parts of the USA that acts as a habitat-forming foundation species under the tree canopy, and hosts a wide range of invertebrate species – some of them exclusive to Spanish moss. To disentangle the effects of habitat complexity and the trophic role of *Tillandsia* in driving invertebrate diversity, we experimentally compared real Spanish moss (habitat + food) with plastic mimics (habitat only), and bare branches. We then used stable isotopes and a trait-based community analysis to unravel differences among treatments after 3 months. We found that the spatial structure of *Tillandsia* is vital in providing habitat for many species. However, our analyses show that *Tillandsia* acts as an important food source for part of the invertebrate community. We conclude that foundation species may often have a hierarchical, dual role in ecosystems (1) facilitating species by providing spatial structure and (2) key trophic resources to the species they facilitate.

4. Steering community establishment – how do sowing and soil inoculation affect above- and belowground communities over two decades

Jasper Wubs, Wim van der Putten, Simon Mortimer, Gerard Korthals, Henk Duyts, Elly Morriën, Martijn Bezemer
Netherlands Institute of Ecology

In terrestrial ecosystems the plant and soil community strongly interact and it is thought that their interplay is an important driver of community development. The community establishment and development may be manipulated by above- or belowground interventions. It is, however, unclear whether the key control points on subsequent development lie above- or belowground, or whether there is synergy in combined intervention. We conducted a long-term field experiment on ex-arable land where we manipulated above-and belowground community composition using sowing and soil inoculation. We used mid-succession plant species and a mid-succession grassland soil to sow and inoculate, respectively, in a full factorial design and we monitored the establishment of plant and nematode communities for 20 years. The data show that the established plant communities were mostly influenced by sowing, while the nematode community responded most strongly to soil

inoculation and these effects were persistent. In addition, sowing also significantly affected nematode community establishment, probably due to changes in resource quality due to changes in the plant community composition. We conclude that above- and belowground interventions can independently steer plant and soil community establishment respectively to a large extend, and this may offer scope for rescuing and restoring both plant and soil biodiversity. In addition, management practises impinging on plant community composition can be used to indirectly alter soil community composition, through bottom-up trophic cascades.

5. Harnessing or breaking facilitation: the dual role of positive interactions in coastal restoration

Valérie Reijers, Marloes van den Akker, Peter Cruijsen, Leon Lamers, Tjisse van der Heide
Radboud University Nijmegen

Recent work on coastal restoration has shown that incorporating facilitation theory can greatly enhance restoration success of degraded wetlands. However, when coastal ecosystems are threatened by invading habitat-modifying species their positive interactions can hamper restoration success and instead facilitate the further spread of the invader. In this study we focussed on understanding the facilitative mechanisms leading to the invasion of common reed (*Phragmites australis)* in salt marshes along the Atlantic coast. To test the effect of positive interactions in mitigating the negative effect of saline conditions we assigned two stages of reed sods (pioneer and intact) to saline and freshwater conditions in a full factorial design. We found a two-fold higher growth rate and survival in the intact sods compared to the pioneer stage when grown in saline conditions. The intact sods were able to overcome seawater stress by aerating the soil, thus lowering the concentration of toxic sulphide, and promoting the infiltration of rainwater, leading to decreased salinity stress. These results clearly show that intraspecific facilitation is responsible for the persistence of common reed in salt marshes ecosystems. We emphasize the importance of integrating positive interaction in coastal restoration, but argue that they should be either harnessed or broken depending on the context.

6. The return of Flat oyster in North Sea and Dutch coastal waters: restoring a *biocoenosis*

Tom van der Have, Joost Bergsma, Martijn Dorenbosch, Pauline Kamermans, Wouter Lengkeek, Hein Sas, Aad Smaal
Bureau Waardenburg

Flat oysters (*Ostrea edulis*) were once common in the soft sediments of the Dutch part of the North Sea (Central Oyster grounds) and estuaries in the Delta and northern Zuiderzee. They formed extensive biogenic reefs with a high diversity of associated organisms. In 1883, when the reefs were already in decline, this biotic association was named by Karl Möbius a *biocoenosis*, half a century before Tansley coined the term *ecosystem*. In the first half of the 20th century these biogenic reefs completely disappeared from the North Sea due to a variety of factors, including overexploitation, bottom disturbance and emerging infectious diseases. Flat oysters are males during the first three years (protandrous) and subsequently alternating hermaphrodites. Fertilization is internal, the larvae are brooded and development is completed during a short, pelagic stage. As a result, dispersal of larvae is limited. Establishment or setting of larvae exclusively occurs on hard substrate, usually on shells, which is a limiting resource in soft sediments. Restoration, therefore, should include both the creation of a source of larvae and settlement substrate. During the first stage of a restoration project of shellfish banks a mixed flat oyster – Pacific oyster reefs was discovered in the Voordelta (North Sea coastal zone). Studies of the distribution of flat oyster larvae combined with hydrodynamical models simulating dispersal suggests that this population probably originates from the Grevelingen. Settling substrate provided by mussel and Pacific oyster shells was available in a small stretch of soft sediments without bottom disturbance. These results will be discussed in relation to nonlinear models, which predict alternative stable states based on oyster survival, shell accretion and sediment deposition in other oyster species. Feasibility studies for flat oyster restoration show that suitable conditions are increasingly available in the Wadden Sea and North sea.

3d: Changing species interactions and ecosystem functioning in the Anthropocene

Conveners: Wendy Jesse (Vrije Universiteit Amsterdam)
Estefania Velilla (Vrije Universiteit Amsterdam)
Lisette de Senerpont Domis (Netherlands Institute of Ecology)

1. Changing species interactions and ecosystem functioning in the Anthropocene

Lisette de Senerpont Domis
Netherlands Institute of Ecology

Anthropogenic stress comes in many forms, such as land use change, (light, sound, chemical) pollution, over-fertilization, and species introductions. In this introductory talk we will introduce the framework of planetary boundaries for understanding the impact of anthropogenic stressors on ecosystem functioning, and how science can contribute to safe operating space for humanity. We will illustrate our overview with examples from our own work.

2. Third generation sequencing as a tool for African great ape conservation

Ineke Knot, David Greer, Robbie Rae, Alex Piel, Serge Wich
University of Amsterdam

Great apes are declining sharply due to anthropogenic pressure. This reduction is mainly due to the loss, fragmentation, and degradation of great ape habitats and hunting for bushmeat. This causes significant pressure on the remaining great apes, all of which are classified as Endangered or Critically Endangered by the IUCN Red List of Threatened Species. Increased anthropogenic pressure has caused another threat: infectious diseases that can be transmitted between humans and wildlife, also known as anthropozoonotic diseases. This calls for extensive health monitoring, both of great apes as well of human populations and domestic animals. Recent developments in sequencing have the potential to create new opportunities in health monitoring on remote locations. In this presentation I discuss the potential of the MinION nanopore sequencer, a revolutionary portable sequencing device, as a tool in great ape conservation.

3. Integration of exotic plants into native insect herbivore networks

Menno Schilthuizen, Kim Meijer, Chris Smit, Barbara Gravendeel, Leo Beukeboom
Naturalis Biodiversity Center

As time since establishment increases, exotic plants tend to gather a denser network of native herbivores and at the same time become less invasive. Understanding the development of such exotic-native networks is therefore crucial to forecasting the long-term effects of species invasions. We studied the tritrophic aspects of developing insect communities on introduced plants in the Netherlands. We found numerous complex eco-evolutionary interactions that suggest that one-dimensional invasive species management may not always be fruitful.

4. Arsenic contamination in the groundwater and soil and subsequent transmission in the edible crops in Bengal Delta

Sayan Bhattacharya
Nalanda University

The Bengal basin is considered as the most acutely arsenic affected geological province in the world. The research work was performed in a part of Bengal Delta [Kalinarayanpur (23°14' N, 88°59' E), Nadia, West Bengal, India]. Arsenic (As) contents in the water samples and sediment layers were analysed. Oxidizable organic carbon (OOC) and organic matter (OM) of the soil samples were also measured. A strong correlation was found between the distribution of As and OOC. Rice and jute plant samples of different age groups were studied for arsenic bioaccumulation. There was a time-dependent decline of arsenic content in the diverse parts of *Oryza sativa*. Accumulation of arsenic showed a root> basal stem> median stem> apical stem> leaves> grains trend in *Oryza sativa*. *Corchorus capsularis* followed a trend of arsenic bioaccumulation similar to *Oryza sativa*. The overall scenario can reflect that the contamination of arsenic in water, soil as well as in the food chain in Bengal Delta must be addressed properly to understand the importance of arsenic exposure from food sources.

5. Joint effects of warming, terrestrial DOC, and atmospheric nitrogen deposition on mountain lake microbial communities

Marika Schulhof, Andrew Allen, Eric Allen, Natalie Mladenov, Celia Symons, Hamanda Cavalheri, John McCrow, Jessica Blanton, Jonathan Shurin
University of California

Climate warming, associated increases in terrestrial dissolved organic carbon (DOC) supply to lakes, and atmospheric nitrogen (N) deposition are major environmental stressors affecting the sensitive lake ecosystems of the Sierra Nevada mountains in California, USA. Climate change, DOC quality and quantity, and nutrient pollution can shift food web structure and ecosystem function through bottom-up processes controlled by microbial communities that influence biogeochemical cycling and trophic

structure. The purpose of this study was to determine the independent and interactive effects of temperature, terrestrial DOC loading, and N deposition on microbial community composition in lakes. We sampled thirty-five lakes across gradients in elevation (temperature, DOC) and N deposition (measured as NO3-) in Sequoia National Park, Yosemite National Park, and Inyo National Forest. We measured physical and chemical variables in lakes and determined bacterial community composition via 16S rRNA gene sequencing. Results suggest that DOC source and algal productivity are significant, independent drivers of changes in bacterial community composition in lakes across elevation gradients.

6. The impact of artificial light at night on plant-pollinator interactions

Eva Knop
University of Bern

Artificial lighting is rapidly increasing yet the consequences for biodiversity and ecosystem functioning are barely known. We experimentally tested how plant-pollinator interactions are altered due to artificial light at night, and what consequences it has for the plant reproductive output of a common plant, *Cirsium oleraceum*. We experimentally illuminated seven independent field sites in the Swiss pre-alps, using mobile LED-street lamps. All sites were in a generally dark area and had previously no artificial light sources within at least 100 m. At these sites and seven dark control sites we quantified nocturnal plant-pollinator interactions and analysed changes in network structure due to artificial lighting. Further, we assessed the reproductive success *C. oleraceum* on dark control and illuminated sites. We show that plant-pollinator interactions are disrupted due to artificial light at night, and that this can translates to a reduced reproductive output of plants. Our results suggest that artificial light at night is a novel threat to pollination by changing plant-pollinator interactions.

3e: Benthic-pelagic coupling on shallow to deep reef ecosystems

Conveners: Jasper de Goeij (University of Amsterdam)
Nicole de Voogd (Naturalis Biodiversity Center)
Arie Vonk (University of Amsterdam)

1. Sponges bring life to shallow and deep coral reefs: From cells to ecosystems

Jasper de Goeij
University of Amsterdam

Ever since Darwin's early descriptions of reefs, it has been a mystery how one of earth's most productive and diverse ecosystems thrives in oligotrophic seas, as an oasis in a marine desert. The recently discovered sponge loop pathway shows how sponges efficiently retain and transfer energy and nutrients on reefs, recognizing their role as key ecosystem drivers. Evidence now accumulates on sponge loops in other ecosystems, such as deep-sea coral reefs. As a result, current reef food web models lacking sponge-driven resource cycling are incomplete and need to be redeveloped. However, mechanisms that determine the capacity of sponge 'engines', how they are fuelled, and drive communities are unknown. I will discuss the establishment of a novel reef food web framework. Existing critical knowledge gaps at both organismal and community scale will be identified. Sponges possess functional traits in the processing of dissolved food, the main fuel of the sponge engine. But to what extent are they a driving force in structuring reef ecosystems, from fuel input (primary producers), to engine output (driving and modulating the consumer food web)? The sponge-driven food web will be a much-needed foundation to test and predict future changes on tropical shallow to cold-water deep-sea reefs.

2. Survival in a feast-famine environment: Resource utilization and storage in cold-water coral *Lophelia pertus*

Sandra Maier, Tina Kutti, Raymond Bannister, Pieter van Rijswijk, Peter van Breugel, Evert de Froe, Dick van Oevelen
Royal Netherlands Institute of Sea Research

Cold-water coral (CWC) reefs play a major role in carbon cycling in the deep-sea, but their high productivity and diversity stands in sharp contrast to infrequently available resources. Organic matter is exported from surface ocean to deep sea in short peaks creating feast feeding conditions intermitted by long famine periods. This natural environmental gradient might be enforced due to global change, likely resulting in lower export production. Further, climate change and ocean acidification potentially increase CWC energetic demands. To understand the resource processing and allocation in the most common CWC species *Lophelia pertusa*, we simulated a feast-famine sequence and traced resource processing and allocation using stable isotope enrichment. Corals' metabolization, loss and storage of an algal food peak was followed over four weeks. Our results indicate that *L. pertusa* invests energy from a short food peak directly to build new biomass, and store excess carbon in organic storage pools. Stored resources are subsequently depleted to almost 50% within four weeks of starvation, via continued metabolization of food carbon through respiration and organic carbon release in terms of mucus. Resource availability, utilization and energy allocation of those ecosystem engineers are discussed as key factors to study resilience towards global climate change.

3. Environmental and geological drivers of deep-sea sponge grounds

Ulrike Hanz, Gert-Jan Reichart, Marc Lavaleye, Claudia Wienberg, Dierk Hebbeln, Christian Dullo, Furu Mienis
Royal Netherlands Institute for Sea Research / Utrecht University

Deep-sea sponge grounds are hypothesized to play a key ecological role in the benthic-pelagic coupling. This project investigates environmental and geological drivers enabling sponge grounds to establish in the Atlantic Ocean. Here we present short and long term variations of physical and geochemical properties of the overlaying water column, which were measured by hydro-cast transects and lander deployments in two areas along the southwestern coast of Africa. This area is the most productive coastal upwelling system in the modern ocean and nutrient rich coastal waters contribute to the appearance of an oxygen minimum zone (OMZ). Even though oxygen concentrations are extremely low the areas is characterized by rich communities of deep-sea sponges associated with cold-water coral grounds. The appearance of sponges in this area reaches far into the OMZ, where they thrive in oxygen concentrations of 0-0.3 mg/l. Expanding and retracting of the OMZ border due to diurnal tidal waves increases the distribution range due to temporary increased oxygen concentrations. We assume that the appearance of sponges in this area is connected to the high availability of organic matter, counteracting the oxygen-stress. These results implicate that sponges could play an important ecological role especially in more extreme environments, where other reef building organisms are already excluded.

4. Benthic-pelagic coupling in tropical seagrass meadows

Arie Vonk
University of Amsterdam

Seagrass meadows are amongst the most productive ecosystems in the world and provide habitat for a diverse faunal community. Even under oligotrophic conditions that characterize many reef-flat ecosystems, tropical seagrasses can maintain a year-round high productivity. Seagrass meadows therefore need to recover losses of nutrients from the plants induced by detachment of leaves through hydrodynamics or grazing. Capture of various organic sources from the water column by benthic fauna species can replenish lost resources in tropical coastal ecosystems, as observed for bivalves in sand flats, sponges on coral reefs, and crustaceans in mangroves. However, the relative importance of these different functional fauna groups generating an influx of organic matter in tropical seagrass meadows is largely unknown. I will discuss the importance of sponges, bivalves and crustaceans in capturing organic sources in tropical seagrass meadows and potential impact of changes in infauna composition on organic matter fluxes. Combining data on functional traits related to the use of various organic resources, e.g. dissolved organic matter, particulate organic matter, phytoplankton, availability and quality of these organic resources and fauna densities in seagrass meadows, this presentation provides an overview of the relative importance of infauna species on benthic-pelagic coupling in these tropical reef-flat ecosystems.

5. How cold-water coral mounds on the Rockall Bank have outgrown themselves

Furu Mienis, Gerard Duineveld, Marc Lavaleye, Christian Mohn, Frederic Cyr, Hans van Haren, Christophe Colin
Royal Netherlands Institute for Sea Research / Utrecht University

Colony-forming cold-water corals are a clear example of globally occurring ecosystem engineers, modifying the seafloor landscape in the deep-sea at large scales. Kilometres long and up to 360 m high mound structures have formed on the SE Rockall Bank. Coral growth in the area is sustained by the advection of fresh particles derived from primary productivity, which are associated with warm waters flowing down the slope. Earlier observations showed that most of the mounds have their summits around 550 m water depth and summits have been reported as being covered with living corals. Recent cruises revealed completely new insights in coral reef development. Video transects across mounds with different morphology showed that summits of the largest mounds are presently not covered by living coral as opposed to smaller mounds, which are covered with a thriving living coral framework. Near-bottom and water column measurements showed that turbulence is likely the most important factor influencing nutrient and food supply and thus coral growth. Large mounds have outgrown themselves and their large size and flat summits are limiting turbulence, thereby limiting oxygen, nutrient and food replenishment, which is vital for ecosystem functioning and reef development.

6. Trophic interactions between fish, corals and algae on a reef in Kenya

Ronald Osinga, Ewout Knoester
Wageningen University & Research

We simultaneously studied the impact of herbivory and corallivory by reef fishes on coral fragments in sea-based aquaculture at a shallow reef near Shimoni, Southeast Kenya. Forty-five experimental aquaculture structures were deployed at a depth of 4-6 meter, each structure holding ten replicate fragments of the stony coral *Acropora verweyi*. Three types of structures were used: uncaged structures, allowing access to fish, caged structures (fish excluded) and open cage controls. Herbivory and corallivory on the structures were monitored by Remote Underwater Video (RUV). Effects on corals were determined by measuring the growth of the corals during a four month interval. Fouling that had developed onto the structures was quantified at the end of the four month period. Positive effects of herbivory (i.e. reduction of fouling) outweighed negative effects of corralivory: corals in caged culture frames exhibited significantly lower survival and growth rates, specific growth rates being 40% lower in the absence of fish. Algal biomass on the caged structures was 100 fold higher than algal biomass on uncaged structures and open cage control. We conclude that reef fishes may aid coral mariculture by reducing the need for man-mediated cleaning of fouling.

Parallel Session 4

4a: Eco-evolutionary theory

Conveners: Hanna ten Brink (University of Amsterdam)
Boris Kramer (University of Groningen)

1. A genetic matrix population model for eco-evolutionary dynamics

Charlotte de Vries, Hal Caswell
University of Amsterdam

The study of eco-evolutionary dynamics is based on the idea that ecological and evolutionary processes may operate on the same, or very similar, time scales. If they operate on similar time scales, feedbacks between ecological and evolutionary processes may have important consequences for both sides of the eco-evolutionary dividing line. We present a newly developed framework that links simple Mendelian population genetics with matrix population models to create a truly eco-evolutionary model. There are no limitations on the kinds of ecological processes that can be included in the demographic component of the model: age- or stage-classified life histories of arbitrary complexity, linear or non-linear (density-dependent) dynamics, constant or time-varying (periodic or stochastic) environments. The model can, among other things, generate evolutionary rescue, evolutionary suicide, and selection-driven bifurcations. In the model, genotypes may differ in fertility as well as in viability. The presence of fertility selection threatens the standard usage of genotype-specific population growth rates as measures of fitness. Mean growth rate does not always increase and heterozygote advantage in growth is not a sufficient condition for obtaining a protected polymorphism.

2. Disentangling the contribution of natural selection and population regulation to patterns of phenotypic expression

Romain Richard, Jerome Casas, Edward McCauley
University of Amsterdam

Individual phenotypes are at the core of both ecological and evolutionary theory as they condition both patterns of ecological interactions and the response to natural selection. Since we now acknowledge that evolution can be a significant driver of ecological dynamics (eco-evolutionary dynamics), it becomes increasingly important to account for all processes generating phenotypic variation, especially those associated with feedbacks between ecology and evolution. Such a feedback emerges from the interaction between natural selection and population regulation: whereas natural selection increases the demographic performance of individuals, population regulation implies that their demographic performance must be decreased through concomitant ecological changes. This intimate connection between natural selection and population regulation was recognized by Fisher while deriving his fundamental theorem of natural selection, but the subsequent consequences for emerging patterns of phenotypic variation have been neglected. In this presentation, I will discuss the implications of this eco-evolutionary feedback for patterns of phenotypic expression and illustrate these concepts with examples. This will show that the effects of natural selection resulting from feedback often buffer its direct effects, but they can also reverse or amplify it.

3. A locally and regionally dynamic framework for community assembly

Alex Pigot, Rampal Etienne
University of Groningen

The idea of an external region providing a pool of species from which local communities are assembled (i.e. the 'regional species pool') is one of the conceptual and methodological cornerstones of community ecology. This simple framework, however, is increasingly challenged by the recognition that regional species assemblages are not fixed and immutable entities, but are instead dynamic, changing in composition and diversity through time as new species evolve, disperse and go extinct. Yet, most methods for studying local community assembly ignore these regional dynamics. How species pools are assembled and how these regional dynamics influence the structure of local communities therefore remains poorly understood. To address this, here we develop a new phylogenetic framework for simultaneously modelling the dynamic assembly of both the local community and the regional species pool. Using simulations we demonstrate how the regional dynamics of dispersal, extinction and speciation fundamentally shapes the structure of species assemblages across multiple spatial-scales, including patterns of species richness, phylogenetic and functional structure. We go on to show how these local and regional assembly dynamics can be inferred with high accuracy and reliability given only present day information on community structure and species phylogenetic branching times. With the opportunities provided by advances in phylogenetic data and modelling techniques we argue that is now time for community ecology to move beyond a static view of species pools to embrace the dynamic nature of regions in all their evolutionary and biogeographic glory.

4. Ignoring incipient species

Richel Bilderbeek
University of Groningen

The classic birth-death model incorrectly assumes that if a speciation event took place recently, the new species is directly recognized as a good species. Here I want to present the consequence of this often criticized and incorrect assumption. To do so, phylogenies are simulated using a protracted birth-death model, to serve as 'the truth' in nature. DNA alignments true to these phylogenies are generated, to serve as simulated field data. From that data, it is tried to infer the original phylogeny back again, using (one of) the tools already present. The tool chosen is BEAST2, a Bayesian inference tool, for which a standard birth-death model tree prior was set up. Using BEAST2, from the simulated field data, a posterior is inferred and the error between original phylogeny and posterior is quantified with the normalized lineages-through-time statistic. The results indicate that the error made increases with the duration of speciation.

5. Fuel, cargo and the division of labour: a modelling approach

Lia Hemerik, Ron Ydenberg
Wageningen University & Research

In many species animals deliver material to a central place as members of a group, such as a pair or colony. Group members could either work as generalists, when each member self-feed to obtain fuel and deliver cargo, such as food items for offspring, and non-food items such as building materials or as specialists when some members collect solely fuel for their selves and for the member that specialize on getting cargo. With a simple analytical model we have investigated under which conditions division of labour is more advantageous than all doing the same thing. In our modelling approach we assumed that natural selection favours mechanisms that maximize the delivery rate of cargo. Fuel is only important in so far as it enables to support cargo delivery. The model shows that this division of labour boosts the aggregate rate of cargo delivery when the round trip time that a provisioner saves by not having to forage for its own fuel more than offsets the required allocation of group members to exclusive fuel collection. We note that groups with this provisioning division of labour are common in social insects, but appear absent among vertebrates. Several hypotheses may explain this marked difference.

6. Estimating and interpreting migration of Amazonian forests

Edwin Pos, Juan Ernesto Guevara Andino, Daniel Sabatier, Jean-François Molino, Nigel Pitman, Hugo Mogollón, David Neill, Carlos Cerón, Gonzalo Rivas-Torres, Anthony Di Fiore, Raquel Thomas, Milton Tirado, Kenneth Young, Ophelia Wang, Rodrigo Sierra, Roosevelt García-Villacorta, Roderick Zagt, Walter Palacios Cuenca, Milton Aulestia, Hans ter Steege
Utrecht University

Charles Darwin concluded that migration shapes the process of selection just as much as the environment does. However, to study the importance of migration, we must first know how much migration occurs. We explored the use of estimation methods from neutral theory to estimate migration from tree census data and specifically their use in simulations with and without spatial relationships. We show that most methods are able to estimate migration from a world without a spatial relationship (implicit models) but they generally underestimate migration for simulations with a spatial relationship (semi-explicit models). For the latter, estimation is the additive effect of nearby and far away migration but only accurate when migration from far away outweighs that of nearby. We conclude that this is a consequence of how migration is implemented in neutral models, only reflecting how much each locality resembles the summed species pool and hence does not solely capture dispersal, but a myriad of ecological processes causing species turnover. The parameter m of neutral models then appears more as an emerging property revealed by neutral theory instead of being an effective mechanistic parameter and we should move to spatially (semi-) explicit models to infer the importance of migration in shaping diversity.

4b: New insights from large-scale ecology

Conveners: Daniel Kissling (University of Amsterdam)
Hans ter Steege (Naturalis Biodiversity Center)

1. Recent progress in large-scale ecology

Daniel Kissling, Hans ter Steege
University of Amsterdam

Ecology at large spatial and temporal scales has great potential to deliver insights into fundamental ecological and evolutionary principles and processes that generate and maintain the complex distribution of life on Earth. Recent progress in this field has often been driven by the availability of big datasets and recent advances in technology and computing. Here, we highlight and provide examples of five major areas that provide new insights into ecological and evolutionary patterns and dynamics at regional, continental and global spatial scales: (1) massive amounts of species inventory data at fine resolution across large spatial extents, (2) new biogeographic analyses on ecological networks and trophic interactions among multiple species, (3) availability of remote sensing data to characterize ecosystem structure and functioning, (4) global, clade-wide functional trait datasets combined with time-calibrated, species-level phylogenies, and (5) quantification of deep-time abiotic conditions related to paleo-climate, mountain building and sea-level rise. These developments allow a deeper understanding of the distribution of taxonomic, functional, phylogenetic and interaction diversity across our planet and encourage further investments into large-scale ecology.

2. Phylogenetic signal for environmental niche drives the main plant biogeographic patterns of Amazonia

Kyle Dexter, Toby Pennington, Tim Baker, Fernanda Coelho, Euridice Honorio-Coronado, Hans ter Steege, ATDN
University of Edinburgh

There is consensus around several clear biogeographic patterns for trees in Amazonia, with the northeast of the basin dominated by families such as Lecythidaceae and Chrysobalanaceae and the west dominated by other families such as Moraceae, Myristicaceae and Annonaceae. Furthermore, the different biogeographic regions of Amazonia have been posited as centres of origin for families that are most diverse and abundant in those regions. Here we show that this is not necessarily the case. Rather, we argue that phylogenetic signal for environmental niche is likely to be the main driver of biogeographic patterns in the Amazon. We demonstrate that closely related species prefer the same climatic and soil environments, which, in conjunction with previous work that found a clear lack of dispersal limitation across Amazonia on evolutionary timescales, may be sufficient to drive these archetypical Amazonian biogeographic patterns. The environments in the different biogeographic regions of Amazonia are sufficiently distinct and lineages have sufficient dispersal ability, that plant families can spatially aggregate in the biogeographic region with their preferred environment. Our findings suggest a subtle, but important re-think on the biogeography of Amazonia.

3. Identifying plant and animal traits shaping plant-frugivore networks across the Andes

Irene Bender, Daniel Kissling, Pedro Blendinger, Katrin Böhning-Gaese, Isabel Hensen, Ingolf Kühn, Marcia Muñoz, Eike-Lena Neuschulz, Larissa Nowak, Marta Quitián, Francisco Saavedra, Vinicio Santillan, Till Töpfer, Thorsten Wiegand, Matthias Dehling, Matthias Schleuning
German Center for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig / Martin-Luther University Halle-Wittenberg / Senckenberg BiK-F

Interactions between resource and consumer species are organised in ecological networks. One general pattern in these networks is the high level of trait-matching between interacting parties. General interaction rules, however, are still lacking. Here we combine eight interaction networks between frugivorous birds and fleshy-fruited plants from five countries, stretching the majority of the Andean range. We ask which trait combinations lead to plant-animal interactions across sites and which traits determine functional specialization of birds and plants. We applied a meta-analysis of fourth-corner analyses to identify trait-pairs that influence plant-animal interactions along the Andes. All tested trait-pairs had a significant positive effect on the establishment of interactions between plants and birds. Linear mixed-effect models between functional traits and functional specialization (calculated as functional originality) identified traits that determine the level of functional specialization of species. We found that higher crop masses for plants, and longer bills/rounder wings for birds led to higher degrees of functional specialisation. Our findings show that trait-matching in plant-frugivore interaction networks is a general phenomenon across the Andes and we identified key-traits which determine species' level functional specialization. This will help develop general interaction rules needed to make predictions about which pair of species will interact.

4. **LiDAR remote sensing and functional diversity as applied in the Netherlands and the Amazon forest**

Jesús Aguirre-Gutiérrez
Naturalis Biodiversity Center

Biodiversity is rapidly disappearing, affecting the functional diversity of ecosystems. Remote sensing is a tool that has been shown highly effective when investigating local and global drivers of biodiversity change, and recently for mapping species traits. Here, I make use of countrywide Light Detection and Ranging (LiDAR) remote sensing data to show how vegetation structure drives functional and species diversity of butterflies in the Netherlands. For this I use a dataset of c. 3 million observations of 66 Dutch butterfly species, collected across 6075 sampling locations during a period of seven years. Then I discuss how LiDAR and remote sensing can be used to infer plant functional diversity across the Amazon tropical rain forest. I focus here on preliminary results of one of the sampling locations of the Amazon Tree Diversity Network (ATDN).

5. **Frugivory and plant radiations: which ecologies promote speciation in the tropics?**

Renske Onstein, William Baker, Thomas Couvreur, Søren Faurby, Jens-Christian Svenning, Daniel Kissling
University of Amsterdam

Frugivores are of key importance for the functioning of tropical ecosystems, but the extent to which they have influenced plant radiations remains unclear. Here, we tested whether interaction-relevant functional traits (fruit size, growth form) and ecological opportunities (island colonization) affected speciation rates in a keystone tropical plant family: palms (Arecaceae, ca. 2600 species). We combined palm phylogenetic with functional trait and species distribution data and used Bayesian techniques to quantify speciation rates. We detected higher speciation rates of small-fruited compared to large-fruited palm lineages, possibly because frequent long-distance dispersal of large-fruited plants by large-bodied frugivores limits allopatric speciation. Interestingly, island-distributed small-fruited palms in the Old World showed the highest speciation rates, followed by small-fruited understory palms in the New World. The Old World result coincides with the diversity of strong-flying, large-bodied avian frugivores (fruit pigeons and frugivorous hornbills) in Indomalaya and Australasia. These birds may have facilitated the colonization of isolated islands and subsequent speciation. Restricted gene-flow due to short-distance dispersal of sedentary understory frugivores may explain some of the extraordinary radiations of Neotropical understory palm taxa (*Chamaedorea*, *Geonoma*). Our results suggest that frugivory is an important driver of biodiversity, in particular through the functional link between plant traits and seed-disperser ecologies.

6. **A framework for quantifying long-term 10-100ky environmental effects on biodiversity of volcanic and continental islands**

Kenneth Rijsdijk, Sietze Norder, Emiel van Loon, Cyril Hammoud, Simon Buijs, Daniel Kissling
University of Amsterdam

On continents, terrestrial species have the option to migrate in response to environmental change, but on islands they can only choose between adaptation or extinction. A key question is therefore whether evolutionary processes on islands are ultimately controlled by environmental change. The species pump hypothesis postulates that endemic species richness increases with an increase in the amplitude and frequency of environmental change. We designed a framework that allows to assess the effects of climatic and volcanogenic forcing on species richness patterns on islands. We modelled and quantified the effects of area change by sea level change using volcanic islands (n = 60) globally and continental islands of Greece (n = 95). Over the last climate cycle (i.e. since the last interglacial, 120 ky BP) we found that ca 90% of this time span insular areas of all islands were larger in area than at present. For the last 22 ky, the highest magnitudes and rates of change were found on continental islands, with area reductions of up to 90% from the palaeo-areas. In addition, we singled out one active volcanic island of the Azorian archipelago to assess the amount of area change induced by volcanic activity. We found that over once glacial-interglacial cycle, volcanogenic area changes are of the same order of magnitude as area changes caused by sea level changes, suggesting on volcanic islands the role of volcanic additions may be comparable. We will use this area-change framework to assess how area changes influence species richness and ultimately test the species pump hypothesis.

4c: Movement ecology in the Anthropocene

Conveners: Thomas Lameris (Netherlands Institute of Ecology)
Frank van Langevelde (Wageningen University & Research)
Casper van Leeuwen (Utrecht University)

1. Movement ecology in the Anthropocene – session introduction

Thomas Lameris, Frank van Langevelde, Casper van Leeuwen
Netherlands Institute of Ecology

All organisms, ranging from small plant seeds to large rhinoceros, move. Movement helps them to exploit heterogeneously distributed resources, avoid predation or ensure certain climatic conditions. In the Anthropocene, human influence has become a major modifier of organism movement, by destructing and fragmenting habitats, relocating resources, and changing climatic conditions. We aim to connect researchers that work on different aspects of human-influenced movement, in all types of ecosystems. To gain a complete overview, we welcome submissions on all organisms.

2. Rapid evolution of phenology during the recent range expansion of a Mediterranean plant species

Nicky Lustenhouwer, Rutger Wilschut, Wim van der Putten, Jonathan Levine
ETH Zürich

In order to predict population spread rates, from biological invasions to range shifts in response to climate change, it is essential to understand how spreading populations evolve. We studied phenotypic and genetic variation between populations from the core and edge of the range of *Dittrichia graveolens*, a Mediterranean annual plant species which is currently expanding its range northward along highways. In parallel common garden experiments at range edges in Switzerland and the Netherlands, plants were grown from three Dutch, three Swiss, six central French and three southern French populations, using seeds from a common greenhouse generation. We found a strong latitudinal gradient in phenology, where northern plants flowered up to four weeks earlier than southern plants in both common gardens. This gradient extended from the core of the range to the Netherlands, which has only been reached over the last twenty years. Fruit production slowly decreased as plants flowered later, with a sharp drop towards the onset of winter, indicating the end of the growing season as an important selective force in this late-phenology species. Our results suggest that even on short time scales, spreading plant populations can adapt to novel conditions, with potentially large effects on their spread velocity.

3. Trees versus grass: cattle habitat preferences depend on climate

Edwin Bargeman, Henjo de Knegt, Milena Holmgren
Wageningen University & Research

Tree cover will likely expand across tropical and subtropical grasslands as rainfall and climate warming increasingly change the composition and abundance of ecological communities. South American grasslands are highly important for livestock production. Here trees can increase forage and livestock productivity but they can also facilitate woody encroachment and reduce forage area. We examined the movement and behaviour of cattle in relation to tree cover and weather conditions in the subtropical grasslands of central Uruguay. We monitored cows' movement and behaviour using a combination of GPS tracking and visual group observations, and related their habitat selection to tree cover and weather conditions (air temperature and humidity, wind speed and irradiance). During hot conditions (>30°C), cows avoided open grasslands and instead moved to shady wooded areas or to unshaded marshes where stronger winds and access to water allowed faster cooling. In contrast, during cold and windy days, cows preferred the woody patches with higher tree cover to the open windy marshes. Our results show how cattle select habitat conditions depending on microclimate, thereby highlighting the need for designing diverse sylvo-pastoral systems that provide the possibility for cattle to move daily and seasonally towards areas with more benign climatic conditions.

4. Individual modelling of a dolphin near extinction

Geerten Hengeveld, Liz Slooten
Wageningen University & Research

With less than 50 individuals remaining Maui dolphin (*Cephalorhynchus hectori mauii*) are enlisted as critically endangered. Due to their limited home range along New Zealand's Northern Island human (fishing) activity poses a big threat to Maui dolphin. In order to limit interactions with fishermen restrictive zones are established but the effectiveness of the zones is discussed. Low population numbers and legislation limit the possibilities of doing research and conducting experiments with Maui Dolphin. To study the effectiveness of current and alternative no-fishing zones, an agent-based model of dolphin movement is developed. Dolphin movement is parameterised using 1 dimensional movement data from related species, and further calibrated using distribution data from aerial surveys. Simulated encounter rates corresponding to different zonations and densities of fishing activities are used to inform parameter estimates for a Lesliematrix population model. This model will thus illustrate

the impact spatial restrictions on human activities can have on the population dynamics of an endangered species.

5. Human-induced habitat changes influence multiple behavioural stages of dispersal in fragmented habitats

Hugo Robles, Zeno Porro, Carlos Ciudad
University of Antwerp

Despite dispersal, defined as a multi-stage (emigration/departure-transfer/exploration-immigration/ settlement) behavioural process, is a major driver of eco-evolutionary dynamics, the effects of anthropogenic activities on dispersal movements are poorly known due to limited information during exploration-settlement stages. We address this issue by radiotracking juvenile woodpeckers dispersing through novel environments subjected to anthropogenic habitat loss/fragmentation. BCPA and GLMM analyses revealed that juveniles increased search rates (SR) and areas (SA), and reduced thoroughness of search (SA/MCP), when moving on areas with low proportions of breeding habitat (old oak forests) and high proportions of low-quality structures (pine plantations, open areas) at any dispersal stage. In addition, low amounts of breeding habitat surrounding the natal patches were positively correlated with SR-SA during explorations, further supporting the hypothesis that habitat loss/fragmentation and anthropogenic changes in the matrix promote dispersal as a behavioural mechanism to escape adverse conditions. Low SR-SA values were associated with high predation rates and natal population densities, suggesting that, while reduced mobility may increase predation risk, intra-specific competition may constrain movements in the critical early-postfledging period. Because anthropogenic landscape changes (habitat-matrix modifications) alter the distribution of predation risk and competition, dispersal movements are expected to be largely impacted by humans, with dramatic consequences on populations.

6. Limited dispersal evolves through environmental heterogeneity in harsh environments

Monique de Jager
Utrecht University

Rapid anthropogenic global change requires species to either move or adapt to changing conditions. Though it is generally acknowledged that seed dispersal abilities may increase as a consequence of range shifts, evolution of limited dispersal has received less attention. I show that local dispersal can evolve when an initial patchiness of the landscape is in place. Using an integro-differential equation (IDE) model combined with adaptive dynamics, I investigated evolution of responsive dispersal strategies given an environmental stress gradient and a range of patchiness levels of sites suitable for establishment. Depending on environmental stress levels and patchiness of the landscape, human-induced global change can result in either evolution of increased dispersal abilities or dispersal limitation. My results indicate that spatial heterogeneity is a prerequisite for the evolution of local dispersal; without clustering of habitable sites, a local dispersal strategy is disadvantageous and long-range dispersal will evolve.

4d: Trait-based approaches in community- and restoration ecology

Conveners: Michiel Verhofstad (Netherlands Institute of Ecology)
Ralf Aben (Radboud University Nijmegen)
Jerry van Dijk (Utrecht University)
Oscar Franken (Vrije Universiteit Amsterdam)

1. Introducing trait-based approaches in community- and restoration ecology

Jerry van Dijk, Ralf Aben, Oscar Franken, Michiel Verhofstad
Utrecht University

Trait-based approaches have emerged as important tools to understand community dynamics and ecosystem functioning, which often allow for more generality in predictions than more traditional methods based on taxonomy. Trait-based approaches therefore have a high potential for guiding ecosystem restoration measures and predicting environmental change effects on communities and ecosystem functioning. This introduction to the session aims to provide a short overview of recent advances in trait-based ecology, including recognition of the importance of trait plasticity and intraspecific variation in traits along environmental gradients, and an increased identification of suites of traits rather than single traits that predict ecosystem responses to environmental change and ecosystem management. The presentations in this session will present a number of examples of how these advances have improved the application of trait-based approaches in the context of nature restoration, global change ecology and community ecology.

2. Traits-based estimates of diversity across different scales in tundra ecosystems

Eefje de Goede, Nadia Soudzilovskaia, Johannes Cornelissen, Lammert Kooistra, Peter van Bodegom
Leiden University

Functional diversity is expressed at multiple scales. Alpha diversity is related to biodiversity hotspots, whereas beta diversity shows the variation across environmental gradients. Moreover, both alpha and beta functional diversity can be due to inter- and intra-specific variation. This is one of the first studies investigating the extent of intraspecific variation in functional diversity across different scales. Functional diversity was measured across 14 locations in 4 different ecosystem types in Abisko, Sweden. A wide array of traits was measured: SLA (specific leaf area), chlorophyll content, leaf thickness, plant height, leaf water content, and leaf nutrient content (C, N and P). The relative importance of functional diversity within versus between communities, and that of intra- versus interspecific variation, was calculated using variance partitioning to gain important insights into the scale at which most variation in biodiversity occurs. Variance partitioning gives information on the strength of internal and external filtering, on the relative variance within populations, communities and the region, and on whether variation mainly occurs between individuals or populations. First results suggest that intraspecific variation is especially important for beta diversity, increasing in importance with increasing distance between communities.

3. Using root traits to explain changes in biodiversity effects over time

Lisette Bakker, Liesje Mommer, Jasper van Ruijven
Wageningen University & Research

Increased plant community biomass with increasing species richness has often been partitioned into effects of positive biotic interactions (complementarity effects; CE) and the dominance of productive species (selection effects; SE). Consensus is that both contribute, and that CE becomes increasingly important in time. However, the ecological mechanisms behind them are poorly understood. We hypothesize that root trait diversity could lead to resource complementarity belowground, with higher exploitation of nutrients and water in diverse mixtures. Root trait diversity should then be related to increased CE. In addition, SE could be related to community trait means when particular trait values determine species' dominance. We tested this in a biodiversity common garden experiment for two years. On average, we found positive CE and SE in plant mixtures, and both effects increased with time. However, changes in CE were poorly related to root trait diversity. In contrast, changes in SE could be explained by shifts in root trait means: deep-rooting species with high root tissue density performed well in monocultures and greatly contributed to increased biomass in mixtures. Thus, future research should focus explicitly on elucidating the mechanisms underlying CE, and their link to functional traits.

4. From stress to process: species traits as predictor of hydrological effects on soil fauna and, subsequently, litter decomposition

Astra Ooms, Hans Cornelissen, Jacintha Ellers, Matty Berg
Vrije Universiteit Amsterdam

The impact of (extreme) environmental change on biodiversity and ecosystem processes are context dependent. A trait-based approach can be an effective tool to understand, and even predict, the consequences of environmental change on community dynamics and ecosystem functioning. We analyse the predictability of a response-to-effect trait framework. This framework links the shift in soil

fauna community composition to strong soil moisture fluctuations (via the response traits inundation and drought resistance) to litter decomposition (via the effect trait litter consumption). We have measured these traits under standardized laboratory conditions, and show that response and effects traits are linked, which enables to predict how stress affect process. We argue that this framework is applicable for every ecosystem and environmental change, as long as the key organisms and their traits are known and measured.

5. Dispersal strategies of aquatic macroinvertebrates after restoration practices

Judith Westveer, Piet Verdonschot
University of Amsterdam

Lowland streams are highly dynamic water bodies that endure environmental pressure from many different factors. Aquatic macroinvertebrates, the inhabitants of these freshwater environments, are able to disperse to other stretches of stream when conditions become unfavourable. Dispersal capacity of all species depends on the possession and expression of specific traits. However, it remains unknown which key traits or combination of traits lead to successful dispersal and subsequent colonization of stream invertebrates. Furthermore, trait adaptations have phylogenetic constraints, like the constraints of the body plan. Species thus 1) do not necessarily use all of their potential traits, 2) traits will not have equal importance for a species dealing with a specific disturbance and 3) traits will always act in combinations. We have studied these hypotheses in a field situation where we have monitored three restored stretches of stream for two years. All dispersed and colonized species were identified and compared to the upstream source population to determine which traits lead to successful dispersal and which traits have a negative impact on dispersal capacity. The results from this study will contribute to our knowledge of specific life-history strategies and can improve stream restoration efficiency.

6. Plant functional diversity and nutrient availability during fen restoration

Casper van Leeuwen, Jeroen van Zuidam, Liesbeth Bakker, Jos Verhoeven, Merel Soons
Utrecht University

Ecosystem restoration commonly involves the reintroduction of target species and re-establishment of preferred abiotic conditions. The success of restoration projects therefore strongly depends on knowing which target species to introduce, under which abiotic conditions. This knowledge is currently limited for globally diminishing fen ecosystems. We therefore experimentally investigated whether fen formation could be stimulated by increasing functional diversity of the introduced vegetation; and tested whether effects varied over a nutrient gradient (N+P). We compared vegetation development on 126 artificial floating mats that were planted with either one, two or three functional groups of wetland plants. Each mat grew at one of nine different nutrient levels over two years. Mats with higher functional diversity and grown under higher levels of nutrient availability formed more biomass, cover and rhizomes. Biomass and cover increased with functional diversity because of niche complementarity effects (mixed cultures exploited availability resources more efficiently), and rhizome formation increased because of selection effects (higher diversity increased the chance that an important rhizome forming functional group was present). Different functional groups caused this diversity-effect along the gradient of nutrient availability. We conclude that functional diversity and nutrient availability can interactively stimulate fen formation under experimental conditions.

4e: NERN's national biodiversity knowledge agenda Nature4Life

Conveners: Koos Biesmeijer (Naturalis Biodiversity Center)
Johan Mols (Naturalis Biodiversity Center)
Nieke Knoben (Naturalis Biodiversity Center)

1. **Nature4Life Nationale Kennisagenda Biodiversiteit**
   Koos Biesmeijer
   Naturalis Biodiversity Center

2. **No title**
   Han Olff
   University of Groningen

3. **Multitrophic interactions: fundamental knowledge for sustainable food production**
   Joop van Loon
   Wageningen University & Research

4. **Nature4Life Nationale Kennisagenda Biodiversiteit**
   Peter de Ruiter
   University of Amsterdam

5. **Ecology for a circular economy**
   Louise Vet
   Netherlands Institute of Ecology

6. **Green circles: nature as a partner on the road to sustainability**
   Paul Opdam
   Wageningen University & Research

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. Also note that in the last column, you can see to which of the parallel sessions the poster is linked (if applicable).

#	Name	Poster title	Relevant session
1	Irene van Schrojenstein Lantman	Eating and being eaten: Forest biodiversity and fragmentation effects on herbivores	Parallel 1a
2	Sigrid Dassen	Mycorrhizal fungi and plant community dynamics	Parallel 3a
3	Menno Straatsma	Biodiversity changes in 15 years of river restoration in the Netherlands for 28 functional groups	Parallel 1a
4	Suzanne Lommen	The ragweed leaf beetle has landed in Europe: the SMARTER approach to decide whether this is a fortunate coincidence or a threat	Parallel 3a
5	Wu Xiong	Bio-fertilizer application rapidly remodels soil protistan community	Parallel 1a
6	Daan Mertens	Plastic defence strategies as an optimal response to unpredictable multi-herbivore communities	Parallel 3a
7	Esther Bügel / Bob Hendrikx	Zoonotic vector-borne pathogen status in relation to vector burden in Wood mice and Bank voles	Parallel 1b
8	Mohammadhossein Ravanbakhsh	ACC deaminase-producing rhizosphere bacteria modulate plant responses to flooding	Parallel 3a
9	Kay Moisan	Warning or blessing: do plants differentiate between volatiles from pathogenic and non-pathogenic soil-borne fungi?	Parallel 1c
10	Dennis Tippe	Biology and management of parasitic weed species in rain-fed rice ecologies	Parallel 3a
11	Adam Ossowicki	The volatile power of rhizobacteria	Parallel 1c
12	Martijn Vandegehuchte	Mammal-induced trophic cascades in invertebrate food webs are stronger in more intensively grazed subalpine grassland	Parallel 3a
13	Kristin Schulz-Bohm	The prey's scent - can bacterial volatiles affect protists?	Parallel 1c
14	Wei Xue	Plant frequency and plant-soil feedbacks: effects on subsequent growth of two grassland plant populations	Parallel 3a
15	Naomi Zweerus	Who leads the dance?	Parallel 1c

#	Name	Poster title	Relevant session
16	Ellen Decaestecker	Food availability affects the strenghts of mutualistic host-microbiota interactions in *Daphnia magna*	Parallel 3b
17	Manqi Chang	Ensemble modeling to predict algal blooms in polluted lakes	Parallel 1d
18	Stijn Schreven	Bioconversion of oilseed crop residues by insects and associated micro-organisms	Parallel 3b
19	Jan Janse	Linking a local ecological model to global land-use and climate data	Parallel 1d
20	Tanvi Taparia	Suppressive soils for mushroom diseases: A microbiome study	Parallel 3b
21	Christiaan Hummel	The use of Ecosystem Services in Protected Areas	Parallel 2a
22	Celine van Bijsterveldt	Environmental factors driving mangrove establishment and persistence along an eroding coastline	Parallel 3c
23	Alby Duarte Rocha	Naive Overfitting Index: a new method to control overfitting in predictive models of ecological traits from hyperspectral data	Parallel 2b
24	Paula Caroline dos Reis Oliveira	Sand suppletion as a restoration technique in lowland streams	Parallel 3c
25	Thomas Groen	Spectroscopic determination of leaf traits using infrared spectra	Parallel 2b
26	Roeland van de Vijsel	Benthic algae control, the "ON"-switch for mudflat topography formation	Parallel 3c
27	Jelmer Nijp	Quantifying high-resolution spatiotemporal variation of surface elevation in a northern peatland using remote sensing	Parallel 2b
28	Jelmer Samplonius	Competitor timing information affects nest site selection in a migratory bird	Parallel 3d
29	Jelmer Nijp	Spatial vegetation patterns in peatland ecosystems in relation to landscape properties	Parallel 2b
30	Mart Verwijmeren	How rainfall and grazing determine the coexistence and interaction outcome of two plant species in a semi-arid ecosystem	Parallel 3d
31	Hannah Vos	Do earthworms affect phosphorus availability in pastures? A trait-based approach	Parallel 2b
32	Jelmer Zandbergen	Vital soils for sustainable intensification of agriculture	Parallel 3d
33	Libin Zhou	Quantitative and qualitative effects of resource P-limitation on consumer growth rate and life history	Parallel 2b
34	Evert de Froe	Modelling a feeding experiment of the cold-water coral *Lophelia pertusa*	Parallel 3e
35	Paolo Di Lonardo	Priming effect and home field advantage: Combining theories to better understand carbon dynamics in soil	Parallel 2d
36	Louise Lassalle	Changing diet during life, does phenotypic plasticity really matter?	Parallel 4a
37	Rima Porre	Clever Cover Cropping	Parallel 2d

#	Name	Poster title	Relevant session
38	Frederik Mortier	Adaptive habitat choice affects eco-evolutionary dynamics	Parallel 4a
39	Cyrus Mallon	Effects of functional diversity and species richness on the evolution of a synthetic bacterial ecosystem	Parallel 2e
40	Gabriel Muñoz	Aggregating datasets to disentangle biogeographical large-scale functional patterns in palm-frugivore seed dispersal network	Parallel 4b
41	Haidi Abdullah	Detecting the effect of (*Ips typographus* L.) green attack on leaf reflectance	N/A
42	Henk Bolhuis	*Lyngbya aestuarii*: Molecular ecology of a microbial mat builder	N/A
43	Javier Alegria	Harmful algal specie *Alexandrium catenella* bloom propagation	N/A
44	Luc De Bruyn	Habitat connectivity for bats in a small scaled agricultural landscape	Parallel 4c
45	Nathalie Amacker	Protozoa-Bacteria interactions: when the prey rebels	N/A
46	Qingqing Chen	Genotype-based trait variation contributes to the clonal plant *Elytrigia atherica* population expansion	Parallel 4d
47	Karen Brandenburg	Toxic *Alexandrium ostenfeldii* blooms in a Dutch creek	N/A
48	Tisja Daggers	Microphytobenthos versus Phytoplankton: the diet composition of macrobenthos in estuaries along environmental gradients	Parallel 4d
49	Anna Clocchiatti	Stimulating saprotrophic fungi for biocontrol of crop diseases	N/A
50	Oscar Franken	Predictability of species performance under thermal stress	Parallel 4d
51	Loreta Cornacchia	Self-organization of river vegetation regulates water flow and biodiversity	N/A
52	Astra Ooms	FROM STRESS TO PROCESS - species traits as predictor of hydrological effects on soil fauna and litter decomposition	Parallel 4d
53	Mathias Dillen	Do biodiversity effects become more important with stress? Multitrophic interactions between oak, powdery mildew and ladybirds	N/A
54	Aoife Sullivan	Ecosystem functioning in the Baltic Sea	Parallel 4d
55	Nina Fieten	The effect of habitat complexity on predation intensity	N/A
56	Pengfei Zhang	A novel indicator to quantify species competitive ability for light	Parallel 4d
57	Stijn van Gils	How much time does it take to transform a conventional field into organic agriculture?	N/A
58	Jan Kuiper	Scientific use and non-use of GBIF	Parallel 4e
59	Jan van Gils	Body shrinkage due to Arctic warming reduces red knot fitness in tropical wintering range	N/A

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60	Sytske Drost	Greenhouse gas balance and nutrient cycling in winter cover cropping	N/A
61	Alena Gsell	Quantifying change in a pelagic plankton network using long-term data	N/A
62	Annelies van Ginkel	Keep calm and carry on. Behaviour of deer in response to wolf urine	N/A
63	Julia Heinen	Extinction-driven changes in insular frugivore communities	N/A
64	Youk Greeve	The relation between bivalve ecosystem engineers and meiobenthic communities	N/A
65	Viola Kurm	Does bacterial diversity matter in plant insect interactions?	N/A
66	Joao Bosco Gusmao	Seagrass meadow morphology determines the functional diversity of sediment fauna	N/A
67	Casper van Leeuwen	Habitat fragmentation and individual behaviour affect population genetic diversity of a freshwater salmonid	N/A
68	Lucia Irazabal Gonzalez	Comparison of plastic content in grey and harbour seals in the North and Wadden Seas	N/A
69	Haikun Ma	Plant-soil feedback effects on plant growth, disease susceptibility and aboveground defense compounds of a flower crop	N/A
70	Ida Karlsson	Protists as drivers for soil disease suppressiveness	N/A
71	Sanne Moedt	What's for lunch? Food abundance for meadow pipits affected by grazing	N/A
72	Erqin Li	Real-time evolution of mutualistic microbes on plant roots	N/A
73	Raoul van Oosten	The adaptive capacity of the niche-constructing species *Orchestia gammarellus* and consequences for ecosystem processes	N/A
74	Lara Martin-Sanchez	Unravelling the ecological role of bacterial terpenes	N/A
75	Kamiel Spoelstra	Gain and loss of habitat – the response of different bat species to experimental light at night varies with spectral composition	N/A
76	Karin van der Reijden	Habitat-specific exploitation by fisheries in the North Sea	N/A
77	Sanne Van Den Berge	Temporal vegetation changes in hedgerows and forests in the countryside of northern Belgium: lessons to learn	N/A
78	Nils van Rooijen	The living archive: constructing a National Seed Bank in the Netherlands	N/A
79	Joost van Montfort	The landscape approach: scientific challenges emerging from practice in low and middle income countries	N/A
80	Jelle Treep	Evolution of seed dispersal in fragmented landscapes	N/A

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81	Richard Verweij	Woodland ectomycorrhizal fungi have benefitted from large-scale reduction of nitrogen deposition in the Netherlands	N/A
82	Liesbeth Verlinden	Crossing the North Sea: behaviour of nocturnal migrants encountering an ecological barrier	N/A
83	Rutger Wilschut	Do phylogenetic distances help to understand novel plant-soil interaction outcomes?	N/A
84	Klaas Vrieling	SNP genotyping for ecologists	N/A
85	Peiyu Zhang	The effect of temperature on herbivory by the omnivorous cold-blooded gastropod *Lymnaea stagnalis*	N/A
86	Safaa Wasof	Strong linkages between plant, soil microbial and nematode community structures in post-agricultural grasslands under restoration	N/A
87	Tianjie Yang	Resource availability modulates biodiversity-invasion relationships by altering competitive interactions	N/A

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Presentation award instructions

In contrast to previous years the NAEM meeting will not have a Publication award but a Presentation award. This to stimulate young academics to prepare and present an oral presentation of high quality. As usual, there will be a first, second and third prize, € 750,- € 500,- and € 250,- respectively. 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 15 February 2016 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 website / app will be used for this. The procedure is as follows:

- Scan the QR code below, type the following link in your internet browser of your laptop, tablet, or smartphone: https://live.voxvote.com/?pin=73451&autosubmit, or download the "VoxVote Live Voting App" for Android or IOS in the App Store / Play Store and use pin code **73451** to enter the NAEM voting site.
- Vote for the presentation that, in your opinion, was the best of all the presentations you attended during the NAEM meeting.
- 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 17:20 hrs. After this moment the voting site will be closed.
- 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