# CURRENT THEMES IN ECOLOGY (22)

# Ecological Networks

## *Networks in Ecology*

**Thursday 24 November 2016**

Conference Centre de Werelt
Westhofflaan 2, Lunteren, The Netherlands

## PROGRAMME

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|---|---|
| 09:00 – 10:00 | REGISTRATION AND COFFEE / TEA |
| 10:00 – 10:20 | WELCOME AND INTRODUCTION BY CHAIR<br>(Peter de Ruiter, University of Amsterdam) |
| 10:20 – 11:00 | INTEGRATING ECOLOGICAL NETWORKS AND BIOGEOGRAPHY<br>(José Montoya, Centre National de la Recherche Scientifique) |
| 11:00 – 11:30 | COFFEE / TEA |
| 11:30 – 12:10 | STABILITY OF COMPLEX ECOSYSTEMS: THEORY AGAINST DATA<br>(Claire Jacquet, Université de Montpellier / Université de Sherbrooke) |
| 12:10 – 12:50 | NON-TROPHIC FACILITATION AS A KEY-DRIVER OF FOOD WEBS<br>(Tjisse van der Heide, Radboud University Nijmegen) |
| 12:50 – 13:50 | LUNCH |
| 13:50 – 14:30 | ON THE ROLE OF INFECTIOUS DISEASE AGENTS IN ECOSYSTEMS<br>(Hans Heesterbeek, Utrecht University) |
| 14:30 – 15:10 | INTERACTIONS BETWEEN GREEN AND BROWN FOOD WEBS: CONSEQUENCES FOR ECOSYSTEM FUNCTIONING AND STABILITY<br>(Elisa Thébault, Institute of Ecology and Environmental Science) |
| 15:10 – 15:40 | COFFEE / TEA |
| 15:40 – 16:20 | FOOD-WEB STABILITY SIGNALS CRITICAL TRANSITIONS IN SHALLOW LAKES<br>(Jan Kuiper, Netherlands Institute of Ecology) |
| 16:20 – 17:00 | SOIL NETWORKS IN TRANSITION: FROM ABANDONED AGRICULTURAL FIELDS TO SPECIES-RICH GRASSLANDS<br>(Elly Morriën, University of Amsterdam) |
| 17:00 – 18:00 | WRAP-UP OF THE DAY, FOLLOWED BY DRINKS IN THE BAR |


**ORGANISERS:**

Prof. Peter de Ruiter (University of Amsterdam)
Prof. Hans Heesterbeek (Utrecht University)
Dr Claudius van de Vijver (NERN)
Dr Lennart Suselbeek (NERN)



**SUPPORTED BY:**

Netherlands Ecological Research Network (NERN)
NWO Aard- en Levenswetenschappen (NWO-ALW)
Graduate Schools PE&RC, RSEE, and SENSE

## 10:20 INTEGRATING ECOLOGICAL NETWORKS AND BIOGEOGRAPHY

**José Montoya,** Centre National de la Recherche Scientifique

Species interaction network studies and biogeography have evolved independently from each other. Prevailing wisdom is that biotic interactions rule at local-scale networks while large spatial scales are the province of climate. In this talk I will argue this and other cross-disciplinary boundaries are artificial, and that much progress can be made through the adoption of both a biogeographical perspective in networks and a network perspective in biogeography. I will present three fundamental ecological questions in which the integration is needed. First, the crucial role of multispecies interactions to explain the latitudinal diversity gradient and to forecast species distributions in a changing world. Second, the existence of large-scale gradients on community structure that depend on the spatial scale of observation, challenging what we know about biotic specialization. And third, the impact of changes in the distribution ranges of species on several network properties across an altitudinal gradient. I suggest the network-biogeography integration as one of the most promising yet challenging avenues for network research, food webs in particular, for the coming decade.

## 11:30 STABILITY OF COMPLEX ECOSYSTEMS: THEORY AGAINST DATA

**Claire Jacquet,** Université de Montpellier / Université de Sherbrooke

The relationship between complexity and stability in ecosystems is one of the most long-standing debates in ecology. Early ecologists hypothesized that diversity begets stability, up until R. May showed, with analytical tools borrowed from physics, that the opposite relationship should be expected. For four decades, ecologists have tried to isolate the non-random characteristics of natural ecosystems that could explain how they persist despite their complexity. Surprisingly, few attempts have been tried to test May's fundamental prediction empirically. In this talk, I focus on the analysis of a large dataset of empirically measured food webs. I show that classic descriptors of complexity (species richness, connectance and interaction strength) are not associated with stability in empirical food webs. A further analysis demonstrates that the non-random organization of energy flows between predators and prey allows complex ecosystems to be stable. A next step is to provide a process-based explanation to the emergence of stable, structured food webs. One key functional trait that has been explored in determining food web topology and interaction strengths is species body mass. I propose a mass-based approach to derive food web topology, species energetic needs and equilibrium densities in order to build quantitative realistic food webs.

## 12:10 NON-TROPHIC FACILITATION AS A KEY-DRIVER OF FOOD WEBS

**Tjisse van der Heide,** Radboud University Nijmegen

Food webs are an integral part of every ecosystem on the planet. Although these 'trophic networks' are often studied in isolation, an increasing number of studies suggests that non-trophic species interactions can substantially alter food web structure. Here, we present in-depth empirical and theoretical analyses of how non-trophic facilitation by habitat-modifying organisms affects food web structure across 7 ecosystem types, spanning terrestrial, freshwater and marine ecosystems. Empirical results show that non-trophic facilitation by habitat-modifying species enhances species richness across multiple trophic levels, increases link density, but decreases the realized fraction of all possible links (connectance). Furthermore, a comparative analysis of 'real food webs' with results obtained from an extended version of the niche model reveals that non-trophic facilitation is not specific to any species or functional group, but instead occurs randomly across all trophic levels throughout the food web. Our findings demonstrate that food webs can be fundamentally shaped by interactions outside the trophic network, yet intrinsic to the species participating in it. As habitat-modifying organisms often form the functional foundation of ecosystems, we argue that (1) integration of food webs and non-trophic interactions is an important next step for ecological network analyses, and (2) the use of food web metrics could provide a valuable tool for estimating conservation and restoration success of ecosystems shaped by habitat-modifying organisms.

## 13:50 ON THE ROLE OF INFECTIOUS DISEASE AGENTS IN ECOSYSTEMS

**Hans Heesterbeek,** Utrecht University

Empirical ecological studies that take parasites and pathogens into account are rapidly increasing in both number and diversity. It is becoming clear that infectious disease agents are influenced by the ecology of all species in their ecosystem, hosts and non-hosts, and their interaction, and that vice versa, the ecosystem is influenced by the dynamics and effects of the pathogens and parasites it contains. There are, for example, effects on biodiversity, ecosystem structure, ecosystem stability and resilience. Despite the many and diverse studies and results, a theoretical context in which to study and understand infectious disease agents in ecosystems and food webs is still in early days of development. I will give a number of examples of ecosystem-infectious agent interaction and give a description of initial attempts to study the interaction between ecology and epidemiology. The ultimate aim of the research is to obtain insight into the role that pathogens and parasites play in shaping and maintaining ecosystems as we observe and experience them.

## 14:30 INTERACTIONS BETWEEN GREEN AND BROWN FOOD WEBS: CONSEQUENCES FOR ECOSYSTEM FUNCTIONING AND STABILITY

**Elisa Thébault,** Institute of Ecology and Environmental Sciences

Classical food-web theory on ecosystem functioning and stability has focused either on food webs based on primary production (green food webs) or on food webs based on detritus (brown food webs) and generally ignored nutrient cycling. However, nutrient cycling connects the two food webs, which questions traditional concepts of food web theory. Studying the mechanisms driving the interactions between green and brown food webs is crucial to understand the functioning and the stability of ecosystems. We integrated these two food webs and nutrient cycling into ecosystem models. First, our results show that cascading effects between green and brown food webs depend on distinct mechanisms. The direction and strength of cascading effects of the green food web on decomposer production are determined by the carbon/nutrient limitation of decomposers whereas the effects of the brown food web on primary production are mainly driven by the relative proportion of direct/indirect nutrient cycling in the brown web. Second, our results question the stabilizing effect of asymmetry between energy channels in ecosystems predicted by recent models. We show that asymmetry between green and brown food web channels has either stabilizing or destabilising consequences depending on the stoichiometric mismatch between producers and decomposers.

## 15:40 FOOD-WEB STABILTIY SIGNALS CRITICAL TRANSISTIONS IN SHALLOW LAKES

**Jan Kuiper,** Netherlands Institute of Ecology

The ecosystems of the world are experiencing unprecedented levels of environmental change. A principal aim of ecologists is to identify critical levels of environmental change beyond which ecosystems undergo radical shifts in their functioning. Both food-web theory and alternative stable states theory provide fundamental clues to mechanisms conferring stability to natural systems. Food-web theory generally emphasizes the role of biotic interactions and the importance of network architecture. Alternative stable states theory focusses on positive feedbacks and nonlinear interactions among biotic and abiotic key components in the ecosystem in relation to external forcing. Although both theoretical frameworks are highly influential in modern ecology, it is largely unclear how measures of food-web stability associate with the resilience of ecosystems that are susceptible to regime change. In my research I use a full-scale dynamic ecosystem model of shallow lakes to create a virtual reality where food-web theory and alternative stable states theory can meet. The insights obtained by this research may help resolve the question under which conditions empirical data can be linked to mathematical models to estimate the stability properties of real ecosystems.

## 16:20 SOIL NETWORKS IN TRANSITION: FROM ABANDONED AGRICULTURAL FIELDS TO SPECIES-RICH GRASSLANDS

**Elly Morriën,** University of Amsterdam

The majority of current theory on plant community ecology has been based on vegetation succession at abandoned arable land. This shows how habitat filtering and competition for limiting resources structures plant community composition. Currently, there is consensus that plant community development is the result of those factors, as well as of interactions with their soil community. Here, we address the question how soil community structure affect nitrogen and carbon cycling during secondary succession. In 2011, we visited 9 grassland sites, categorized as recent, mid-term, long-term abandoned ex-arable fields. In total, around 15 000 species were identified from the soils. We created a Spearman-rank correlation matrix based on abundance data of species which we visualized in a network as an overview of the soil community present. In 2012, intact soil cores with comparable plant vegetation were collected from the same sampling points. Stable isotope probing of the cores was performed using dual labelled $^{15}N$ ammonium nitrate ($^{15}NH_4{}^{15}NO_3$) and $^{13}C$ was fed to the plants in the form of $^{13}CO_2$. The soil food web structure was resolved by identifying the microbes using phospholipid markers and identifying soil fauna by morphology into similar groups as for the network analysis, both combined with isotopic measurements.