Dear participants of the workshop in Ecological Theory at Monte Verità,

apologies for the late information about the workshop at Monte Verità. I am looking forward to this event and would like to thank all those who helped in the preparation phase. Please find below the outline of the workshop and the most relevant information at this stage. If you have any questions feel free to contact me directly.

The most important at the start:

1. TRAIN TICKET: If you travel with the group on Sunday from Zurich to Locarno and back to Zurich on Saturday you don't need to buy a train ticket, I will organize this for everyone and the PhD student Stefanie Wagner will distribute the tickets on Sunday morning at the meeting point. The default assumption is return trip with Halbtax and normal ticket for international participants.**If you don't have a Halbtax (GA or regular price instead) please tell me by email (philippe.saner@uzh.ch) as soon as possible!**

2. READINGS: Dan Flynn (dan.flynn@ieu.uzh.ch) kindly uploaded the pdfs of the papers that you are requested to read in preparation for the workshop. It is all available on the Online Learning Platform OLAT and accessible through our homepage: http://www.ieu.uzh.ch/teaching/phd/graduate/structure/sgs/wgs.html

Click on the right hand side to get access to the OLAT platform and access all relevant pdfs. Note that we will not provide print outs of these papers during the workshop. So please bring your laptop and adapters and print only what is really needed. Free WLAN is provided for internet access.

3. REQUIREMENTS: PhD students are expected to work in small (2-3) groups on Monday and Tuesday afternoon on a research proposal draft and can get support of the international experts. The outcome will be presented on Friday to all participants.

Please find below an outline of the week and abstracts for the sessions and talks (if already available).

Sunday, February 3rd

Travel to Monte Verita: Please bring a sandwich as we have no lunch on the arrival day

08:45	Meeting of the group at the Meeting Point, Zurich main station. Distribution of train tickets and transfer to train. Organized by PhD student Stefanie Wagner.
09:01	Departure from Zurich to Bellinzona. The group has a train reservation under "Universität Zürich Ökologie".
11:30	Departure from Bellinzona to Locarno.
11:57	Arrival at Locarno
12:00 - 14:00	Transfer to Monte Verita by shuttle bus
14:00 - 15:00	Check in at Monte Verita
15:00 - 16:00	Registration for the workshop. Participants only: 300 CHF payment in cash or over research group.

16:15 Auditorium: Welcome to Monte Verità and introduction to the workshop (Prof. Dr. Bernhard Schmid, Dr. Philippe Saner, Dr. Paolo Demaria)

16:30 Session I: Introduction to Ecological Theory

A general theory of ecology consists of a description of ecology and a set of fundamental principles. This introductory session will discuss the development of and principles underpinning major ecological theories. The session will overarch the fundamental concepts of ecology that will be presented over the next five days. Among the topics to covered will be the need for and methods of testing for ecological theory, and the interface between conceptual and experimental research.

Prof. Dr. Per Lundberg, Lund University, Sweden (45 mins plus questions)

Asking "What is the role of theory?" is asking "What is science?". In this lecture, I'm going to give a brief overview of the philosophical (epistemological) underpinnings of the natural sciences, especially ecology and evolutionary biology. We will discuss what a mathematical model is and why we need them. I will also discuss inference problems - how we draw conclusions from models and data and what the "frame of inference" means in our discipline. I will illustrate the more "philosophical" problems with how theory and models have been used in ecology.

17:30 Break and welcome drink

17:45 Prof. Dr. Mike Boots, University of Sheffield, UK (45 mins plus questions)

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18:45 General questions and wrap up

19:30 Dinner

Monday, February 4th

07:30 Breakfast

09:00 Session II: Coexistence-Competition (Host: Prof. Dr. Jonathan Levine)

Dr. Simon Hart, Institute of Integrative Biology, ETHZ (45 mins plus questions)

Among the most enduring mysteries in ecology is how multiple plant species, all competing for the same handful of limiting resources, coexist. Classic theory shows that stable coexistence requires competitors to differ in their niches, and this finding has motivated countless investigations of ecological differences presumed to maintain diversity. That niche differences are key to coexistence, however, has recently been challenged by the neutral theory, which explains coexistence by the equivalence of competitors. The ensuing controversy has motivated calls for better understanding the collective importance of niche differences for the diversity observed in natural systems. In a series of presentations, we will first explore how the maintenance of species diversity can be understood in terms of niche and fitness differences between competitors, and how species trait and phylogenetic differences relate to these controls over the outcome competition. We will next explore explanations for diversity maintenance focusing on the role of variation among individuals in their traits and vital rates. We will examine how variation among individuals reveals species level variation that is difficult to ascertain without exploring dynamics at the individual level. Empirical examples from forest environments will be

presented to illustrate these points. We will next examine general rules for when and how individual variation per se influences the outcome of competition. At completion of the session, students will understand the leading approaches to exploring how species diversity is maintained.

10:00 Morning break

10:30 Prof. Dr. James Clark, Duke University, USA (45 mins plus questions)
Species interactions at the individual scale in a changing climate. The recent global increase in forest mortality episodes could not have been predicted from current vegetation models that are calibrated to regional climate data. Future biodiversity depends on how climate impacts are mediated by the interactions that determine coexistence. In a series of publications we have shown that evidence for niche partitioning is available at the individual scale. Likewise, physiological studies show that recent mortality episodes involve interactions between climate and competition at the individual scale. Just as models of coexistence have omitted interactions at the individual scale, models of forest response to climate do not include interactions because they are hard to estimate and require long-term observations on individual trees obtained at frequent (annual) intervals. A new approach provides estimates of climate-competition interactions in two critical ways, 1) among individuals, as a joint distribution of responses to combinations of inputs, such as resources and climate, and 2) within individuals, due to allocation requirements that control outputs, such as demographic rates. Application to 20 years of data from climate and competition gradients shows that interactions control forest responses, and their omission from models leads to inaccurate predictions. Species most vulnerable to increasing aridity are not those that show the largest growth response to precipitation, but rather depend on interactions with the local resource environment. This first assessment of regional species vulnerability that is based on the scale at which climate operates, individual trees competing for carbon and water, supports predictions of potential savannification in the southeastern US.

12:15 Lunch break

14:00 Prof. Dr. James Clark, Duke University, USA (45 mins plus questions)
Climate change and length of the growing season: conflicting evidence and new predictions. Near-term increases in productivity will occur if phenology responds to climate warming with prolonged growing seasons. This possibility is supported by some long-term observational studies showing advancing budbreak that coincides with warming climate. Other studies suggest that local adaption cued by photoperiod can limit phenological response. Limited response to climate change has adaptive value, guarding against damage from late frost in spring and early frost in fall. The price of this muted response is missed opportunity to fully exploit the potential growing season. Due to the challenges for experiments and models it has been difficult to determine how responsive phenology will be to climate change. Based on a large experimental warming study we show how models of experimental data provide a detailed time course of phenological development that is missed in previous studies. Experimental warming of air and soils at Duke Forest, NC and Harvard Forest, MA allowed us to evaluate the effects of warming on spring phenological development. To properly assimilate discrete ordinal classes of phenological observations (e.g., bud swelling to full leaf explansion) we developed a state-space model for continuous phenological change, driven by temperature and seed source, with multinomial likelihood. We compared the effects of temperature on phenology with results obtained by a standard thermal (degree-day) model. Results challenge the basic assumptions of thermal models for spring phenology. We found substantial phenological response and large differences between individuals of different species. In contrast to traditional degree-day models, which assume differences in thermal efficiency as a principle driver for timing of budbreak, we find

this effect to be small. Predictive distributions for the effects of climate warming based on uncertainty in the process model and observations predict responses to 4°C warming that range from near zero to advances of up to 2 weeks. For some species we found that the seed source had a strong effect on response to warming, but not all. The approach could be applied to other data sets, where monitoring of environmental variables is continuous, and phenological observations consist of interval censored ordinal classes.

15:00 Afternoon break

15:15 Introduction to the group work: Preparing a research proposal (Prof. Dr. Bernhard Schmid)

18:15 General questions and wrap up

19:00 Dinner

Tuesday, February 5th

07:30 Breakfast

09:00 Session III: Causes and Consequences of Extinctions (Host: Prof. Dr. Owen Petchey)

Each year between 0.1 and 0.01 % of the world's species go extinct. That is, with about 1.8 million scientifically identified species, between 180 and 1.800 species vanishing year by year. But the actual losses are expected to be much higher since we don't know exactly how many species there are. Moreover, the recent species loss is 1.000 times faster than the background or natural extinction rate. We crucially depend on a diverse planet. The loss of species will affect our wellbeing directly and indirectly. Thus, the search for the causes will help us to avoid extinctions; and by understanding the consequences arising from extinctions we will be able to disrupt potential cascade effects and mitigate the impacts of species loss. However, identifying the causes and consequences of extinctions is one of the most challenging parts of ecological research. Species are part of a community and form complex networks of interactions. The ways species interact with each other are countless comprising competition, predation, parasitism, commensalism, mutualism and antagonism, just to mention a few. Thus, changes in the state of one species are likely to affect other species and therefore being carried forward throughout the community. The question are: How strong are other species affected? And how far are impacts carried forward. To answer these questions and to test for hypothesized mechanisms, ecologists conduct experiments and perform model simulations. This day of the workshop will give an overview on how to investigate extinctions and their impacts on communities and ecosystems. We will tell you about the possible interactions involved and when they are becoming important. Further, we will show you how to tackle the difficulties appearing when investigating complex interaction networks.

Prof. Dr. Per Lundberg, Lund University, Sweden (45 mins plus questions)

The routes to extinction. Extinctions happen when the population size become very small and eventually vanishes. Why are some populations small and others large? How do large populations become small? This lecture will deal with some basics in demography. I will also discuss environmental and demographic stochasticity, how to do stochastic population modeling and the basics of population viability analysis (PVA). Finally, I will discuss briefly the role of dispersal and population connectivity.

10:00 Morning break

10:30 Prof. Dr. Per Lundberg, Lund University, Sweden (45 mins plus questions)

Community responses to extinctions. When a species (population) goes locally (or globally) extinct, that should have consequences for the community in which that species is embedded. Several things can happen, for example, nothing at all (or very little), extinction cascades, ecological and evolutionary rescues, or community closure (the problem of restoring disrupted communities). I will also briefly discuss the phylogeography of extinctions in metacommunities.

12:15 Lunch break

14:00 Dr. Rudolf Philippe Rohr, Doñana Biological Station Sevilla, Spain (45 mins plus questions)

I will give a lecture on the dynamic and species extinction in mutualistic networks. I will start the lecture by introducing a dynamical model of mutualistic interactions. Then, I will explain how the specific architecture of a mutualistic network (nestedness) increases the structural stability and can prevent species extinctions. Finally, I will present new results relating species resilience with their network position under rapid change in interaction strength. Interestingly, I will show that the direction of the change leads to different results in which species is going to be extinct the first.

15:00 Afternoon break

15:15 Continuation of the group work: Preparing a research proposal

18:15 General questions and wrap up

19:00 Dinner

Wednesday, February 6th

07:30 Breakfast

09:00 Session IV: Host-Parasite Interactions (Host: Prof. Dr. Jukka Jokela)

Prof. Dr. Jukka Jokela, Aquatic Ecology, EAWAG (45 mins plus questions)

Host-Parasite interactions are a fundamental component of individual, population and community ecology. Parasites and pathogens are common and drive ecological and evolutionary responses in their host populations, which are reciprocated by the parasite and pathogen populations. Dynamics of host parasite interactions are modeled using different approaches. Some models base on population biology, while some base on ecological and evolutionary genetics. Mathematical models provide ample opportunities for testing the specific hypotheses of coevolution, disease dynamics and population level effects of pathogens. Purpose of this session is to give an overview of ecological and evolutionary models of coevolution. We aim at covering both infectious disease agents and classical parasites; their epidemiology, evolution of virulence and life-history traits. We specifically discuss how co-evolutionary models can be used to study ecological interactions, spatial and temporal heterogeneity and specificity. We give an overview, with examples, on how different models are tested and applied.

10:00 Morning break

10:30 Prof. Dr. Mike Boots, University of Sheffield, UK (45 mins plus

questions)

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12:15 Lunch break

14:00 Free afternoon for the workshop participants
14:00 PIs only: LSZGS Ecology interviews with PhD candidates (all afternoon)
15:00 Afternoon break

19:00 Dinner

Thursday, February 7th

07:30 Breakfast
09:00 Session V: Metacommunity Theory / Ecological Networks (Dr. Florian Altermatt)

Understanding the distribution of species, their abundance, and their interactions with other species is the central theme of ecology. The study of how spatial dynamics explain the origin and maintenance of biodiversity is a relatively young domain, founded in the work on island biogeography. The rapid loss and fragmentation of habitats because of human activities has further increased the interest in spatial ecology, and has fostered the study of metacommunity dynamics. A metacommunity is defined as a set of local communities that are linked by dispersal. For single species, the metapopulation concept addresses how dispersal connecting a set of local populations can compensate for local extinction and enable the regional persistence of a species. While explicitly addressing different spatial scales, the metapopulation concept ignores that species may affect each other's birth and death rates. Metacommunity ecology explicitly addresses interactions among species at different spatial scales and addresses how species interactions can influence or be influenced by spatial dynamics. Thereby, the concept of metacommunities combines two common features of many biological systems, namely that species are interacting in complex ways and that spatial heterogeneity and fragmentation leads to fragments of suitable habitat patches in a matrix of non-habitat. Importantly, species interactions can affect spatial processes, and vice versa. Current interest is mostly in understanding which types of interactions are occurring at different spatial scales, and understanding the relative importance of species interactions and dispersal in shaping natural communities. The speakers will give an overview in classic approaches of spatial ecology, specifically focusing on the metacommunity concept. They will highlight current research foci, especially combined evolutionary and ecologically dynamics in spatial ecology.

Dr. Francois Massol, CEFE, France (45 mins plus questions)

This talk will deal with the current state-of-the-art in metacommunity ecology, mostly from the theoretical side. I will introduce classical models and concepts, and show how these models have been adapted to more and more general contexts, passing from community onto ecosystem ecology in the recent years. Some focus will be put on the parts of metacommunity theory that have generated clearly testable patterns and the controversies surrounding these models. I will also summarize some theoretical insights that have come from studying metacommunities from an evolutionary viewpoint. The final part of my talk will describe the new findings and directions that are being taken by theoreticians active in this field of research sensu lato.

10:00 Morning break

10:30 Prof. Dr. Andrew Gonzalez, McGill, Canada (45 mins plus questions)
Applying metacommunity ecology to understand and mitigate the impacts of global change.
My aim is to show how metacommunity ecology can be applied to understand the causes and consequences of biodiversity change. In the first part of my lecture I will show both theoretically and empirically how habitat loss can induce change in the structure of a metacommunity, resulting in species extinction, food web collapse and the disruption of ecosystem function. I will show some evidence that climate change can exacerbate these effects. In the second part of my lecture I will introduce the theory behind the spatial insurance hypothesis (SIH): the idea that the connectivity and environmental heterogeneity of a metacommunity can explain the maintenance of biodiversity, and the function and stability of ecosystems at local and regional scales. I will then present some experimental evidence for the SIH. Given these findings I will close with the idea of ecological networks for conservation that is founded upon the metacommunity concept, and give the example of an ecological network for Montreal that applies this concept to the real world.

12:15 Lunch break

14:00 Session VI: Formulating and Fitting Mechanistic Models
Dr. Matthew Smith, Microsoft Research Cambridge, UK (45 mins plus questions)
In this session we will attempt different modelling paradigms for formulating and fitting mechanistic models. We are all aware that there are a lot of options out there. Stochastic versus deterministic, ODEs, PDEs, difference equations, individual based models, Bayesian inference versus least squares. I have used most of them in my time and hopefully you will too. What is critical is to not let the research with the models drift too far away from the real world. Here we will attempt these different paradigms and identify ways we can work to prevent replacing a world we are attempting to understand with models that we don't understand.

15:00 Afternoon break

15:15 Group work

18:15 General questions and wrap up

19:00 Dinner

Friday, February 8th

07:30 Breakfast

09:00 Research proposal presentation
PhD students present and discuss the research proposals they developed during the week with the international experts.

10:00 Morning break

12:15 Lunch break

14:00 Research proposal presentation
Students present and discuss the research proposals they developed

during the week with the international experts.

15:00 Afternoon break

17:30 General questions and wrap up

19:00 Social dinner at Osteria Nostrana in Ascona (10 min walk)

Saturday, February 9th

07:30 Breakfast

09:00 Participant feedback and distribution of workshop certificates. Discussion of the future development of the research training in the PhD Program in Ecology.

10:00 Morning break. Collect lunch pack.

10:15 Check out

10:30 - 11:45 Shuttle from Monte Verita to Locarno
12:03 Departure from Locarno to Bellinzona
12:34 Departure from Bellinzona to Zurich main station
14:49 Arrival at Zürich HB

I am looking forward to an exciting workshop. Please contact me for any additional questions or concerns you may have.

Contact details of Philippe Saner:
Email for general questions: philippe.saner@uzh.ch
Mobile for emergencies: 0041 76 581 8188 (international) / 076 581 8188 (within Switzerland)

With best wishes,
Philippe