PhD Program in Ecology

Universität Zürich
Institut für Evolutionsbiologie
und Umweltwissenschaften
Winterthurerstrasse 190
CH-8057 Zürich
Telefon +41 44 635 54 87
Email phdecology@ieu.uzh.ch
http://www.phd-ecology.uzh.ch

"Life Science Zurich Graduate School
PhD Program in Ecology
Annual Meeting and Symposium"
Program

1 March 2017

RAA-G-01, Aula. Rämistrasse 59
Zurich, Switzerland

1 March 2017

09:00 – 10:00 **PhD Networking session**

09:00 – 10:00 **Brunch, RAA-Lichthof**

PhD students networking opportunity with:

Jeremy Fox
https://dynamicecology.wordpress.com/author/oikosjeremy/

Sharon Lawler
http://entomology.ucdavis.edu/Faculty/Sharon_Lawler/Lawler_Research/

Jana Petermann
https://petermannlab.wordpress.com/about/jana-petermann/

Tobias Züst
http://www.plant-insect.org/index.html

10:00 – 10:30 **Break-out groups: Brainstorming working groups**

Group 1: Principal Investigators (Chair: Owen Petchey).

Group 2: PhD Students (Chair: Debra Zuppinger-Dingley).

Symposium

Chair: Aurélie Garnier, PhD Program in Ecology

11:00 – 11:10 **Owen Petchey**
'Opening address'
Director; University of Zurich, Switzerland

11:10 – 11:15 **Debra Zuppinger-Dingley**
'Facts and Figures'
Coordinator; University of Zurich, Switzerland

11:15 – 12:05 **Keynote - Sharon Lawler**
'Is contemporary evolution affecting interactions between amphibians and invasive natural enemies?'
University of California Davis, U.S.A.

12:05 – 13:15 Lunch

Session 2 Chair: Dominik Behr, PhD Program in Ecology

13:15 – 13:45 **PhD Program in Ecology Alumni: Tobias Züst**
'The role of plant secondary metabolites in plant-insect coevolution '
University of Bern, Switzerland

13:45 – 14:00 **Aurélie Garnier**
'Scale dependent synergies between multiple environmental stressors in microcosm ecosystems'
PhD Program in Ecology; University of Zurich, Switzerland

14:00 – 14:15 **Gianalberto Losapio**
'Network response to environmental changes: integrating plant interactions, network theory and functional traits'
PhD Program in Ecology; University of Zurich, Switzerland

14:15 – 14:30 **Yana Yankova**
'Climate induced changes of the metalimnion and consequences for the harmful cyanobacterium Planktothrix rubescens'
PhD Program in Ecology; University of Zurich, Switzerland

14:30 – 14:45 **Cheng Choon Ang**
'Genetic diversity of two tropical trees (Dipterocarpaceae) following enrichment-planting strategy in Borneo: negative impact of planting in monocultures'
PhD Program in Ecology; University of Zurich, Switzerland

14:45 – 15:15 **Coffee**

15:15 – 15:45 **PhD Program in Ecology Alumni: Jana Petermann**
'Aquatic microecosystems in forests: what bromeliads and tree holes can tell us about community ecology'
University of Salzburg, Austria

15:45 – 16:30 **Keynote: Jeremy Fox**
'The spatial hydra effect: that which does not kill metapopulations makes them stronger'
University of Calgary, Canada

16:30 – 16:40 **Owen Petchey**
'Closing'
Director; University of Zurich, Switzerland

16:40 – 18:00 **Apéro and Poster Session**

RAA-Lichthof

How to get there

Tram line number 10, stop ETH/Universitätsspital, walk downhill to the venue (Rämistrasse 59).

Tram Line number 9, stop Kantonsschule which is just in front of the venue (Rämistrasse 59).

Abstracts
Presentations

Cheng Choon Ang
Genetic diversity of two tropical trees (Dipterocarpaceae) following enrichment-plating strategy in Borneo: negative impact of planting in monocultures.
Tropical rainforests are well known for being the most species-rich of all the terrestrial ecosystems on earth. However, biodiversity in these forests is under threat due to logging and land-use conversion. Many restoration efforts focus on recovering species diversity and forest structure post-logging, but fewer have emphasized genetic diversity within species, which plays an important role in species adaptation to and persistence under novel climates and biological interactions. Therefore, we aimed to provide a detailed assessment of genetic diversity among seedlings used for enrichment planting for the restoration of selectively logged forests in Sabah, Malaysia, and to compare it with the levels in naturally regenerating seedlings. We sampled enrichment-planted seedlings from two dipterocarp species (*Shorea leprosula* and *Parashorea malaanonan*) within the Sabah Biodiversity Experiment (SBE) restoration project and compared their levels of genetic diversity with those natural seedlings from the surrounding forests. Our results showed that the genetic diversity estimates (heterozygosity and rarefied allelic richness) varied significantly between natural and enrichment-planted seedlings, particularly in *S. leprosula*. Interestingly, a reduction of genetic diversity was consistently observed in monocultures relative to the mixed-species plots in both species from the enrichment-planting site. This reduction of genetic diversity was likely caused by selective mortality of genotypes in monocultures over the last 13 years post-planting mortality, relative to that of the 16-species mixtures. The selective loss in monocultures may be the result of increased-density-dependent mortality, which would likely to remove genotypes that are poor competitors. Therefore, in the future, forest restoration of tropical tree species should adopt more species-rich planting schemes to prevent the loss of within-species genetic diversity associated with low species diversity.

JeremyFox
The spatial hydra effect: that which does not kill metapopulations makes them stronger.
Many species occupying patchy habitats comprise metapopulations: local populations connected by dispersal, allowing recolonization of extinct populations. Metapopulation persistence requires asynchrony; simultaneous crashes of all populations would leave no source of recolonization. Anything that prevents spatial synchrony therefore should promote metapopulation persistence. I will show theoretically and experimentally that catastrophic population extinctions themselves can promote metapopulation persistence, by inhibiting spatial synchrony and thus enhancing recolonization. A population wiped out by a local catastrophic event and subsequently recolonized requires time to resynchronize with other populations. Local extinctions thus both create the need for recolonization, and ensure the availability of an adequate supply of recolonists by preventing synchrony. The effect is robust, occurring in a wide range of systems exhibiting cyclic or quasi-cyclic population dynamics. Irefer to this behaviour as the 'spatial hydra effect': as with the mythical hydra that grows two new heads when one is cut off, that which does not kill metapopulations makes them stronger.

Aurélie Garnier
Scale dependent synergies between multiple environmental stressors in microcosm ecosystems.
Global environmental change has negative impacts on ecological systems, impacting the goods and services they provide. Whereas effects of individual stressors are reasonably well understood, we lack information about if and how multiple stressors interact. We examined interactions among four stressors (temperature, nutrient ratio, resource enrichment, and light) in a fully factorial design using a microbial aquatic ecosystem and observed responses of dissolved oxygen saturation at three temporal scales (resistance, resilience and return time). We tested whether multiple stressors combine in a dominant, additive or interactive fashion, and compared the predictability of dissolved oxygen across scales.
Enrichment and shading reduced oxygen concentration in the short-term (i.e. resistance); whereas no other effect or interaction was significant, resistance decreases as the number of stressors increased. In the medium-term, only enrichment accelerated recovery, but none of the other effects (including interactions) were significant. In the long-term, enrichment and shading lengthened return times, and we found significant two-way interactions between stressors.
The best performing model (dominant, additive or interactive) depended on the temporal scale of response. In the short-term (i.e. for resistance), the dominance model predicted resistance of community respiration best, due to a large effect of carbon enrichment, whereas none of the models could predict the medium-term (i.e. resilience). The long-term response was best predicted by models including interactions among stressors. Our results indicate that appropriate hypothesis and models of the effects of environmental stressors on ecosystems will need to account for the temporal scale of responses being considered.

Sharon P. Lawler
Is contemporary evolution affecting interactions between amphibians and invasive natural enemies?
Invasive predators and pathogens are contributing to global amphibian decline. My research group has studied the ecological and possible evolutionary effects of invasive trout, a chytrid fungus, and American Bullfrogs on two frogs of special concern: the Cascades Frog, *Rana cascadae* and the California Red-legged Frog, *Rana draytonii*. Trout introduced into mountain lakes in the 1950's extirpated many populations of *R. cascadae*. Not only do trout eat tadpoles, but our studies indicated that they also compete with adult frogs and support high densities of a predaceous snake, causing 'hyperpredation' (a form of apparent competition). *R. cascadae* only persisted in fishless lakes and in lakes with complex habitat that were close to fishless lakes. We restored several frog populations via trout removal. Unfortunately, restored and other populations were soon infected by a pathogen that is causing a global pandemic among amphibians, the fungus *Batrachochytrium dendrobatidis* (*Bd*). One of our largest restored populations declined rapidly. We detected a new *Bd* strain in this population that was more virulent than other regional strains. This is consistent with evolutionary epidemiology theory predicting that dense populations promote hypervirulent strains. Not only may invasive natural enemies evolve, but intense selection by new predators may lead to rapid evolution of prey defenses. We tested for differences in behavioral responses to trout scent cues between *R. cascadae* tadpoles from populations that were sympatric with trout versus allopatric, raising tadpoles from eggs to minimize artifacts. Tadpoles from all population types responded to trout scent by decreasing activity and hiding, but sympatric populations foraged less and hid more in the absence of cues. Although maternal effects cannot be ruled out, results are consistent with contemporary evolution of a fixed response to fish presence. *R. draytonii* is in decline in part due to intraguild predation from the invasive American Bullfrog *(Lithobates catesbieana*). We found that *R. draytonii* tadpoles from populations that were sympatric with bullfrogs responded to their scent by decreasing activity early in development and increasing activity later, while those from allopatric populations did not respond detectably. However, a mesocosm study failed to confirm that the apparent behavioural adaptation was beneficial, possibly due to effects of insect predators in the community. This shows that changes due to natural selection may have high costs in some contexts. Overall, this body of research shows that understanding contemporary issues in conservation ecology can benefit greatly by incorporating concepts drawn from community ecology, epidemiology and evolution.

Gianalberto Losapio

Network response to environmental changes: integrating plant interactions, network theory and functional traits.

Plant interactions are fundamental processes for structuring plant communities and are an important mechanism governing the response of plant species and communities to environmental changes. Thus, understanding the role played by the interaction network in modulating the impact of environmental changes on plant community composition and diversity is crucial. Here, we aimed to develop a new analytical and conceptual framework to evaluate the responses of plant communities to environmental changes. This framework uses functional traits as sensitivity measures for simulated environmental changes and assesses the consequences of microhabitat loss. We show here its application to an alpine plant community where we recorded functional traits (specific leaf area [SLA] and leaf dry matter content [LDMC) of all plants associated with three foundation species or the surrounding open areas. We then simulated primary species loss based on different scenarios of environmental change and explored community persistence to the loss of foundation species. Generally, plant community responses differed among environmental change scenarios. In a scenario of increasing drought alone (i.e. species with lower LDMC were lost first) or increasing drought with increasing temperature (i.e. species with lower LDMC and higher SLA were lost first), the plant community resisted because drought-tolerant foundation species tolerated those deteriorating conditions. However, in scenarios with increasing nitrogen input (i.e. species having lower SLA were lost earlier), foundation species accelerated species loss due to their early primary extinctions and the corresponding secondary extinctions of species associated to their microhabitat. The resistance of a plant community depends on the driver of environmental change, meaning that the prediction of the fate of this system is depending on the knowledge of the main driver of environmental change. Our framework provides a mechanistic understanding of an ecosystem response to such environmental changes thanks to the integration of biology-informed criteria of species sensitivities to environmental factors into a network of interacting species.

Jana Petermann

Aquatic microecosystems in forests: what bromeliads and tree holes can tell us about community ecology.

Species coexistence and interactions have interested ecologists, including me, for a long time. Aquatic microecosystems such as waterfilled bromeliads and tree holes offer ideal conditions for the study of communities in simple but realistic food web and metacommunity contexts. I will present some of our research on bromeliad-inhabiting communities in tropical forests in Costa Rica and Brazil as well as some results from our tree-hole projects in temperate forests in Germany. I will show you that this research is fun, but I hope I can also convince you that we can learn a lot from these small model systems and can potentially upscale results to larger systems at the landscape-scale.

Yana Yankova

Climate induced changes of the metalimnion and consequences for the harmful cyanobacterium Planktothrix rubescens.

Climate warming impacts Lake Zurich (Switzerland) by increasing surface water temperatures, reducing spring mixing depths and supporting the proliferation of the toxic low-light adapted facultative-metalimnetic cyanobacterium *P. rubescens*. We investigated its habitat changes by determining the spatio-temporal boundaries of the metalimnion subjecting long-term water temperature data (1978-2013, weekly measurements) to low-pass filtering and binary thresholding. A significant preponed shift in onset (17 d) and a longer duration (33 d) of the metalimnion due to increasing temperatures were detected. Furthermore, the metalimnion exhibited a decrease in thickness due to drawdown of the upper boundary by 2.3 meter. Nevertheless, changes in spatio-temporal metalimnion characteristics did not affect the net growth of *P. rubescens* during the months in which it is located in this zone (July-September). This is linked to the fact that the zone of optimal light (neutral buoyancy) conditions still remained within the boundaries of the metalimnion during summer. Moreover, an increase of metalimnetic temperatures in August even positively influenced the cyanobacterial biomass. However, a further drawdown of the upper metalimnetic boundary due to ongoing lake warming might force the cyanobacterium into the turbulent and light oversaturated epilimnetic layer. This might have severe negative consequences for the further development of *P. rubescens* in the studied ecosystem.

Tobias Züst

The role of plant secondary metabolites in plant-insect coevolution.

Consumption of plant tissue by herbivores is one of the most frequent ecological interactions occurring in any particular ecosystem. As they are sessile, plants have limited abilities to escape herbivores, and primarily rely on a series of defensive strategies to minimize damage to their tissues and loss of resources. As one key element of defense, plants express a diversity of secondary metabolites – chemical compounds intended to deter or poison the plant's enemies. In turn, herbivores that specialize on specific host plants often have evolved strategies to cope with their host's toxins, and may even co-opt plant defenses for their own benefit, for example through sequestration. Plant secondary metabolites are therefore key traits that both mediate and are shaped by plant-herbivore co-evolution.In an overview of key results from my previous and ongoing research, I will demonstrate how herbivores can shape the defensive phenotype of plants. In turn, I will demonstrate how variation in plant chemical composition can affect performance and distribution of herbivores in natural communities both directly, through selective pressures, and indirectly, through the interaction with higher trophic levels. In particular, I will highlight how we are beginning to understand the causes and consequences of the often vast intraspecific chemical diversity found in most plant species, and how this diversity can be of key importance in determining relative success of plants and their enemies.

Posters

Dominik Behr
Dispersal and its demographic consequences in the endangered African wild dog (Lycaon pictus)
Dispersal of individuals is an important process governing the population dynamics of socially and spatially structured populations. However, there is a mismatch between our understanding of the complexity of dispersal and our representation of dispersal in models of population dynamics. This is largely due to technological limitation and our inability to follow the fate and whereabouts of dispersing individuals. In a rapid changing word, failure to incorporate the complexity of sociality and dispersal in population dynamic models can have severe conservation and management consequences. This is particularly undesirable for threatened species such as the highly endangered African wild dog (*Lycaon pictus*) whose population numbers less than 6000 individuals. Here I propose to bring together latest developments in radio-tracking technology and 25 years of individual-based data on within-group demography to provide an explicit investigation of dispersal in a socially and spatially structured population of African wild dogs in the Okavango Delta ecosystem in northern Botswana. Specifically, I aim to explore the patterns and mechanisms of dispersal, the resulting population-dynamic implications of dispersal, and present scientific evidence for the implementation of effective conservation strategies. For this I will deploy GPS/Satellite radio collars on a minimum of 30 dispersing individuals to closely follow their movements and monitor their dispersal success (e.g. survival rate and reproductive success after settlement). I will then use available long-term demographic data and novel dispersal data to investigate the population-dynamic and evolutionary consequences of dispersal in wild dogs at an unprecedented detail level. By placing dispersal into a wider ecological context, this project will increase our fundamental biological understanding of dispersal and help improve our ability to predict and manage the responses to environmental and anthropogenic perturbations of endangered carnivores living in socially and spatially structured populations. This project will provide an important scientific insight for evidence-based conservation of the African wild dog. The African wild dog is a charismatic and iconic symbol of conservation efforts of an entire continent.

Sebastián Block Munguia
Plant community responses to climate change.
Novel competitors can shape plant community responses to climate change, but the timescales of their effects are poorly understood. During my PhD, I will integrate field experiments with mechanistic models to explore the relative timescales of community dynamics driven by novel competitors and by changing interactions among current competitors. I will also explore the usefulness of functional traits as predictors of species responses to changing climates and competitive environments.

Giorgia Camperio-Ciani

Molecular traces of Anthropogenic and Climatic impact in Remote Oceania (MACRO).

The MACRO project will use novel molecular isotopic approaches to disentangle the climatic and anthropogenic effects in shaping cultural landscapes on remote Pacific Islands. The timing and extent of human impact on previously unoccupied island ecosystems of Remote Oceania has long been debated, as sizable changes in climate occurred at the time of human colonization in the mid-late Holocene. Islands represent ideal microcosms to study processes that are relevant in the current context of global changes but difficult to address on a planetary scale such as changes in land-use and soil loss.

Through the multi-proxy analysis of lakes and swamps sediment cores, the MACRO project will provide combined paleoclimatic and paleoenvironmental reconstructions. Organic fossil molecules (biomarkers) will be at the center of these investigations. The arrival of humans and subsequent evolution of population size will be documented by variations in coprostanol (faecal biomarker) and bile acid. New biomarkers will be developed to trace the introduction of allochthonous cultivars such as taro or sweet potato. The main innovative approach of MACRO will be the use of compound-specific radiocarbon as a tool to assess soil degradation accompanying the cultural evolution. The age of terrestrial biomarkers deposited in sedimentary basins, which provide information on soil carbon cycling in the catchment, will be combined with conventional indicators of soil erosion to evaluate prehistoric human impacts on soils (e.g. pollen, trace elements, charcoal).

Past variations in rainfall intensity – the most prominent climate variable in this region – will be reconstructed from the hydrogen and carbon isotopic composition of aquatic and terrestrial plant lipids. The impact of rainfall and cyclones on soils will be assessed in pre-settlement sediments. By comparing several islands with diverse environmental trajectories and under distinct climatic influences, the MACRO project will contribute to clarifying the tight interplay between human, climate and the environment in forming a sustainable society."

Giulia Donati

Unravelling coral reef fish biodiversity.

The understanding of the micro evolutionary processes shaping fish diversity in coral reefs, is fundamental (i) to assess the potential impacts of ongoing and future environmental changes and (ii) to improve marine conservation management practices. In particular, understanding gene flow is essential to design appropriate marine protected areas. Using a network of coral reef systems in the Western Indian Ocean, we will quantify gene flow and investigate how and why it varies among the species investigated. We will relate species life-history traits such as larval duration, egg laying strategy or fish size to the level of gene flow. Further, we are interested to investigate intra-specific functional variability, which also corresponds to a facet of coral reef fish diversity. We developed an innovative and non-invasive sampling tool to measure body traits, which provides information on the species swimming abilities. This device consists of an underwater double camera system, which is able to perform 3D morphological reconstructions of reef fishes from fish videos. Using those images, we aim to investigate whether intra-specific morphological variations are associated to different habitats within coral reefs, and whether this as well depends on species life-history traits.

Mariana Gliesch

The role of phosphorus partitioning in plant species coexistence.

Resource partitioning is one of the recognized mechanisms by which species can increase their niche differences and hence their probability of coexistence. Plants are limited by just a few resources and phosphorus (P) is one of them. P can be taken up by plant roots only as inorganic phosphate, but it is present in soil in many different forms on which plants could possibly specialize. Although P-partitioning is commonly regarded as an important mechanism driving species diversity on P poor soils, there is no clear empirical evidence demonstrating that P specialization is relevant for species coexistence. Therefore, the aims of this project are: 1) to theoretically determine the set of conditions under which two plant species competing for P can coexist; 2) to investigate how potentially coexisting species differ in their P uptake patterns and in their influence on soil P and 3) to determine if these differences lead to coexistence between species pairs in the field. My study system is a P-limited mountain grassland on an acidic soil rich in Fe and Al oxides and organic matter. The first aim will be achieved through mathematical modelling. For the second aim, I am running greenhouse experiments in which I investigate how eight plant species grow when supplied with different P forms and how they modify P availability in soil. For the third aim, the same eight species are growing in a density gradient of intra- and interspecific competitors to quantify niche differences between them. The final output of my project will be to link the results of all three parts and to therefore establish the role of P partitioning in plant species coexistence.

Lorenzo Lagostina

Microbial community zonation across a natural organic matter gradient spanning the Namibian shelf.

Despite tremendous advances in the study of microbial biogeography in subsurface marine sediments, little is known about the factors determining community structure or the metabolism of the majority of subsurface microbes. In particular, the relationship between organic matter (OM) composition and microbial community structure is poorly understood. Since OM can differ considerably in terms of chemical composition depending on age, source and sedimentary settings, we hypothesize that the macromolecular composition of buried OM is a key factor shaping subseafloor microbial communities. To address our hypothesis, we characterized microbial community composition on a transect spanning from the continental shelf to the abyssal plain across one of the most productive marine ecosystems on Earth, the Benguela Upwelling System. Preliminary results show vertical and lateral zonation of communities: within the first meter typical surface sediment groups (Proteobacteria, Thaumarchaeota) progressively decrease and are replaced by characteristic subsurface taxa (Atribacteria, Chloroflexi, Bathyarchaeota and Lokiarchaeaota). Coastal non-bioturbated sites show dominance of Thermoplasmata and absence of Thaumarchaeota, opposite of what is observed approaching the abyssal plain. To further elucidate how microbial metabolic potential is changing across the continental margin we analyzed – supported by CoDL - the metagenomes of three subsurface samples representative of different sedimentary settings: inner shelf, depositional center and continental rise. Parallel to the microbial community and metagenome analyses, detailed characterization of the OM present in the transect will be performed. Predominant macromolecular building blocks of the OM will be determined by GC-pyrolysis. The diagenetic status of the OM will be inferred using amino-acid nitrogen to total nitrogen ratios and amino-acid composition-based indicators. Biomarker analysis (GDGTs, alkenones, alcohols) will elucidate the origins of the OM. This extensive organic geochemical dataset will be related to the genetic information through multivariate statistical analysis to test whether certain phylogenetic groups are associated with specific OM fingerprints.

Dechen Lham

Snow leopard distribution, abundance and ecology in Bhutan.

The snow leopard *Panthera uncia* is one of world's rarest cats, and conservation of its remnant populations is faced with multiple threats and challenges, including habitat fragmentation and degradation, declining prey base, retaliatory killing, illegal trade, weak policies, insufficient transboundary cooperation, and lack of scientific information. Globally, snow leopards are found only in twelve countries. Bhutan lies at the southern periphery of the species' range and represents an important corridor between the Indian and Chinese populations. It is important to understand the basic ecology and life-history characteristics, population dynamics, predator-prey dynamics, genetic diversity, movement ecology and spatial connectivity, and human-wildlife interactions in order to take appropriate and timely conservation action to prevent global extinction. In Bhutan, very little is known about the snow leopard's ecology, and basic information on distribution, abundance, diet, and degree of conflict with rural communities are lacking. My research, divided among four main chapters, aims to fill this important information gap for the conservation of the snow leopard in Bhutan. The first chapter will investigate the distribution and abundance of snow leopards across Bhutan and identify the underlying environmental and anthropogenic factors. The second chapter will investigate the genetic variability of snow leopards across Bhutan to assess the degree of connectivity among the protected areas of the country. The third chapter will characterize the regional and seasonal dietary habits of snow leopards with particular focus on the differences between wild and domestic prey. My fourth and final chapter will evaluate human perception towards snow leopards in Bhutan and determine the degree of human-wildlife conflict and its causes. As a result of this PhD work, I will provide evidence-based recommendations for conservation strategies and interventions, and develop an effective snow leopard management plan for Bhutan. The results from my project will shed light into the population health and life history characteristics of this elusive cat, and also help meet Bhutan's national snow leopard conservation goal to "maintain a viable interconnected population of breeding snow leopards in Bhutan and interconnected transboundary landscape; a population existing predominantly on wild prey and in harmonious coexistence with the communities.

Alejandra Parreño

Interactions and feedbacks between land use change, biodiversity and productivity.

Global change drivers are phenomena such as climate change, habitat change, pollution and over-exploitation, that affect the Earth system and its capacity to sustain life. Biodiversity plays an important role in the maintenance and resilience of ecosystems to global change. While there are numerous studies reporting the effects of these drivers in changes in biodiversity levels and disruption of ecosystem functions, data is reported in heterogeneous ways and remains largely scattered. Moreover, there are synergistic effects of global change drivers for which is necessary to also look at feedbacks and interactions at different scales, as opposed to studying them in isolation. In this meta-analysis, I show the results of a preliminary study of the feedbacks within 3 variables: land use/landcover change, species richness and net primary productivity. I integrate data on the effects among these variables between the years 2000-2016 in order to report a net effect of one variable in the other, conjointly. Furthermore, I quantify the proportion of the heterogeneity of data available that can be explain with different moderators, most importantly type of ecosystem where the effect was reported and intensity of the effect variables. In all, I highlight global patterns that may be hard to appreciate with non-quantitative, non-integrative reviews.

Gianna Pitsch

Co-occurrence networks in aquatic food webs: ciliates as models.

Elucidating interactions between organisms and their implications for ecosystem functioning is still a great challenge in freshwater ecology. Major components in aquatic food webs are microscopic organisms, including viruses, bacteria, protists and small metazoans. Among protists, autotrophic phytoplankton, heterotrophic flagellates and ciliates belong to the key players. During my PhD I mainly focus on ciliates as model organisms to reveal co-occurrence networks and interactions in freshwater microbial food webs. For this purpose, we investigate two distinct food webs varying in scale and complexity. (i) The less complex consists of the microbiome colonizing the feeding traps of the aquatic plant *Utricularia reflexa*. This microbiome seems to be a highly specific assemblage of prokaryotes and eukaryotes. Little is known about their interactions and roles in plant life cycle and nutrition. So far we characterized the food web structure and proposed a simplified model for the interactions of its key players. A mixotrophic ciliate belonging to the genus Tetrahymena was found to be abundant inside the feeding traps. Based on morphological and molecular methods we formally described this novel species and named it *T. utricularіae*. In addition to the phenotypical characterisation we explored ecological traits, life strategies and the taxonomic affiliation of this species, which was so far found exclusively in the feeding traps *U. reflexa*. (ii) The second ongoing project deals with the larger and more manifold food web of Lake Zurich. We try to find factors that trigger the variability in ciliate assemblages - among other planktonic organisms - in time (seasonality) and space (spatial distribution). Besides the identification of ciliates based on morphology and molecular analyses, we are going to construct time-lagged co-occurrence networks based on 18S rDNA marker genes. The deduced hypothetical interactions are then tested in lab experiments to clarify defined species-specific (e.g. predator-prey) interactions. Due to high complexity of aquatic ecosystems, they can be hardly investigated thoroughly by a single research group. Thus, this project is carried out in the framework of the D-A-CH program funded by the DFG, FWF and SNF, where three research groups from Germany, Austria, and Switzerland work together. Both projects highlight the importance of combining classical cultivation and morphological identification with sequencing data to get a more holistic picture of species composition and their functional role in aquatic food webs.

Camille Pitteloud

How to document variation in plant-insect interaction networks along the elevation gradient.

My PhD project aims at unravelling the mechanisms that structure the interactions between plant and herbivores to forecast the impact of climate change on natural communities. Due to good dispersal abilities, herbivores are expected to track climate change faster than plants, shaping new co-occurrences and possibly interaction networks. This increase of herbivory pressure on alpine plant communities is expected to impact alpine plant communities, known to be poorly defended. The deep understanding of those processes first requires to document the current plant-insect interaction networks. In that context, DNA metabarcoding technique, when applied on insect faeces, is a highly informative tool to establish interaction networks. This NGS technique, here based on the amplification of nuclear and chloroplastic plant DNA markers, allows a rapid and accurate identification of the plant species that compose insect diets. This approach will be used to inform about orthopteran-plant interaction networks along six elevation transects distributed across the Swiss Alps. I will then use this ecological knowledge to unravel the mechanisms that are shaping those networks variations along the elevation gradient and to forecast the consequences of climate change on the structure and composition of alpine plant communities.

Josep Ramoneda
Fostering microbial symbiotic functioning for sustainable agriculture: The rooibos model case.
Rooibos, an endemic legume shrub of the South African Fynbos, is a jack-of-all-trades in mineral nutrient acquisition for thriving in exceptionally infertile, acidic and water-deprived soil. As an emerging, locally adapted crop plant, it offers great opportunities for a minimally environmentally invasive and resource-efficient agricultural production. Its symbiotic association to rhizobia and arbuscular mycorrhizal fungi (AMF) for N and P acquisition in a resource-poor soil context makes the focus on these microbial communities particularly pressing. This project aims at linking the composition and diversity of the rooibos' microbial symbiotic communities to plant nutrition, health and stress tolerance (symbiotic community structure-symbiotic interaction functioning-plant performance relationship). Patterns of such relationship are sought by means of a field survey covering a wide range of farms and soil nutrient conditions where cultivations and wild stands lie in proximity, focusing particularly in differences between wild and cultivated populations. A cross factorial pot experiment tests the influence of soil origin (farm), habitat (wild, cultivated or 1:1 mix of soils), sheep manure addition and drought on plant growth and nutrition, where interactions between these factors are expected to inform how symbiotic functioning can be fostered for improving plant performance. Finally, an experiment on strain diversity and competition under different resource and connectivity contexts is planned with the objective of tackling the underlying ecological mechanisms that drive symbiotic functioning in this system. Amplicon sequencing of functional genes and intergenic spacer sequences are expected to provide high taxonomic resolution to describe rhizobial and AMF communities respectively. Stable isotope measurements (δ13C and δ15N), along with soil and leaf total C, N, P and micronutrient measurements are used to assess hydric stress, health, overall nutrition and relative level of biological nitrogen fixation in rooibos plants.

Patrick Scherler[1] and Martin U. Grüebler[1]
Factors affecting prospecting patterns of juvenile red kites (*Milvus milvus*)
Life-history theory suggests that dispersing juvenile animals invest considerable effort in prospecting potential locations before they settle at site of first reproduction. It is likely that this prospecting behaviour varies in relation to intrinsic and extrinsic factors balancing costs and benefits of the behaviour. We investigate the effect of body condition and natal environmental factors on prospecting behaviour during the first period of natal dispersal by tagging a cohort of 44 juvenile red kites (*Milvus milvus*) with GPS-loggers. We found that towards the range margin individuals of high body condition and individuals originating from sites of low breeding density show wide range prospecting movements, whilst distant from the range margin dispersing individuals show small scale prospecting patterns irrespective of their fledging condition. These results suggest that natal habitat characteristics are key factors affecting the information gathered and available for future settlement decisions and thus, natal dispersal distances.
[1]Swiss Ornithological Institute, Seerose 1, CH-6204 Sempach, Switzerland

Andrea Tabi

Predicting the effects of temperature on ecological systems at different levels of organisation.

Predicting temperature effects is crucial in understanding ongoing global change and for generating scenarios for effective policy efforts. This research aims at investigating how well the ecological effects of temperature can be predicted on different levels of organization using experiments with microbial communities.

The empirical part involves a long-term warming and nutrient availability factorial manipulation with microbial communities consisting of protists and bacteria. Short-term functional response experiments will be conducted for parameterizing the predictive models and the simulation study. Effects of treatments on population, community and ecosystem levels will be recorded in order to understand (1) the effect of warming on top-down control (consumer-resource interaction), (2) the effect of any interaction between warming and nutrient addition, (3) the effects of warming across levels of ecological organisation and (4) the predictability of dynamics in the face of different rates of temperature change.

With our systematic empirical investigation across levels of organization I will be able to construct both phenomenological and mechanistic models and test them against data to measure predictability. This will make a contribution to both the theory on predictability and the understanding about temperature effects across levels of ecological organization.

Daniel Wechsler

The Coevolved Web of Life - Assessing the Role of Coevolution in Species Interaction Networks.

The ”Web of Life” is a metaphor for the complex networks arising from species and their diverse interactions. Studies on the structure of these networks have revealed certain general patterns, such as nestedness in mutualistic networks or a modular organization of food webs. While it was found that such structural properties have crucial implications on ecological processes, their effect on species evolution as well as their potential evolutionary origin are less understood. In my PhD, I will explore how the network structure of species interaction networks affects coevolution and how coevolution itself can account for general patterns in these networks (e.g. nestedness). I will do this by means of computational models and the application of concepts form network and evolutionary game theory. By taking into account our knowledge on how genetic changes translate into changes at the phenotypic level (e.g. interaction relevant traits), this work is intended to expand current modelling paradigms in research on (co)-evolution.