Research Area **Ecology and Evolution**

UNIVERSITÄT SALZBURG

MSc-PhD Seminar WS 2022/2023 (LVA 230.340 and 796.300)

January 27th, 2023 – Room C-006 (H34, 3rd floor)

Hosts: Supervisors of MSc- and PhD-projects, Dept. Environment and Biodiversity

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09:00 – 09:15 **Welcome (Ulrike Berninger)**

Session 1 **Chair: Anja Hörger / Ulrike Ruprecht**

09:15 – 09:30 **Christoph Kleinbrucker**
Physiological differences of white and yellow chlorophyll mutants in *Salvia officinalis*

09:30 - 09:45 **Anna Götz**
Diversity of crustose lichens in Sary Chelek, Kyrgyzstan and temporal structuring of the interactions of fungal and phototroph symbiont on landslide deposits

09:45 - 10:00 **Sven Gindorf**
Lichen diversity in the glacier forefield of Ödenwinkelkees (Hohe Tauern, Austria)

10:00 – 10:15 **Mareike Mittag**
LTLDE: Long Term Lichen Diversity Experiment. Myco-, photobiont and microbiome associations

10:15 – 10:30 **Thomas Rupp**
Is there sexual-deception in mediterranean *Aristolochia*?

10:30 – 10:45 **Teresa Baumgartl**
Species and host effects on floral scents in parasitic *Viscum* and their detection by honey bees

Coffee break (10:45 – 11:15, 30 Minutes)

Session 2 **Chair: Peter Steinbacher / Christoph von Hagke**

11:15 - 11:30 **Gladys Kung'u**
Effect of human activities on vegetation structure and arthropod availability in a Kenyan cloud forest: implication for insectivorous birds

11:30 - 11:45 **Anna Sommer**
Aquatic communities in urban micro-ecosystems

11:45 - 12:00 **Florian Hohenberger**
Phytoplankton communities in high alpine lakes of the National Park Hohe Tauern

12:00 – 12:15 **Dominik Hagen**
Quantitative investigation of diatom dispersion in lung tissue of confirmed drowning incidents

12:15 – 12:30 **Kyriakos Nikolaidis**
Consequences of environmental noise on cognitive performance, using a two-digit number comparison paradigm

12:30 – 12:45 **Christoph von Hagke**
Active landscape dynamics and how to quantify them

Lunch break (12:45 – 13:45, 60 Minutes)

Session 3 **Chair: Sabine Agatha**

13:45 - 14:45 **Ulrike Aspöck**
Invited guest speaker - Natural History Museum of Vienna
The Neuropterida (Holometabola : Insecta) - Catalyst for understanding the Evolution and the Universe. A heuristic Contradiction?

Coffee break (14:45 – 15:15, 30 Minutes)

Session 4 **Chair: Bea Apfelbeck / Jonas Eberle**

15:15 – 15:30 **Barbara Stockl**
Community composition of African butterflies in Ethiopian forests

15:30 – 15:45 **Andrea Rimböck**
To bee or not to bee - How land-use and land-restoration affect the local wild bee diversity

15:45 – 16:00 **Dominik Katzenmayer**
Effects of early spring grazing and mowing on flora and fauna in grassland ecosystems: a trait-based analysis

16:00 – 16:15 **Noreen Mutoro**
Modelling of cheetah (*Acinonyx jubatus*) distribution before and after major habitat modification in northern and southern Kenya

16:15 – 16:30 **David Ramsimmer**
Monitoring, conservation measures and population genetic analyses of a small *Bombina variegata* population in Ohlsdorf (Upper Austria)

16:30 – 16:45 **Sam Erpelding**
Ecoacoustic research and its expression through sonic intermedia: species extinction in natural spaces and ecoacoustic composition

16:45 – 17:00 **Closing remarks: Jan Christian Habel**

After the seminar all attendants, speakers, supervisors etc. are invited to stay for the *pizza and beer round table* in the Seminar room.

Anna Götz
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Alexander Paukov, Kerry Knudsen, Ulrik Søchting, Roman Türk, Ulrike Ruprecht

DIVERSITY OF CRUSTOSE LICHENS IN SARY CHELEK, KYRGYZSTAN AND TEMPORAL STRUCTURING OF THE INTERACTIONS OF FUNGAL AND PHOTOTROPH SYMBIONT ON LANDSLIDE DEPOSITS

Kyrgyzstan is characterized by a diverse landscape structure which results in a rich biodiversity. Lichenologically, most of the areas are vastly under-researched and especially knowledge about crustose lichens is rare. Especially in areas where there are many disturbances due to edaphic processes, crustose lichens are a very common group of organisms. But little is known about the temporal structure of lichen communities in depositional areas.
The study was conducted in the Sary Chelek Nature Reserve, Kyrgyzstan. This area is mainly influenced by two high mountain ranges in the north and east and due to this sheltered topography is known for its high biodiversity. Tectonic activity with multiple subsequent landslides have shaped the prevailing landscape and ecosystems and therefore, the investigated habitats along an elevational gradient do not differ only climatically, but also the substrate is diverse, which results in a high number of lichen species. Taxonomic classification was carried out with morphological, chemical and molecular methods. Additionally, newly generated sequences of species that previously had only been described morphologically were included. Several species were reevaluated based on existing literature and/or newly described. The temporal gradient of the different deposits as well as the elevation does not explain species clustering. Moreover, it is noticeable how less structuring the lichen community show despite of habitat variation due to edaphic factors. The specificity of interaction within the lichen organism between phototroph and fungal symbiont shows also remarkably low variation between habitats. Focusing on the most abundant genera and closely related groups *Aspicilia* and *Lobothallia*, it is noticeable that the interaction tends to be more generalist at the main depositional areas.

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Roman Türk, Robert R. Junker and Ulrike Ruprecht

LICHEN DIVERSITY IN THE GLACIER FOREFIELD OF ÖDENWINKELKEES (HOHE TAUERN, AUSTRIA)

Understanding successional processes is fundamental to our knowledge how taxonomic diversity arises. Glacier forefields are excellent “natural laboratories” to study successional processes from bare rock to species-rich vegetation. Lichens are a fundamental part of vegetational succession. However, lichenological studies in glacier forefields are rare and little is known about colonization patterns, so far. To understand adaptive mechanisms in lichens with vegetational succession, we investigated lichen diversity and coverage on 11 representative plots along the successional gradient of the Research Platform Ödenwinkel (Junker et al., 2020). The species composition of the dominant symbiotic partners was analyzed with molecular tools (Sanger sequencing), coverage data was assessed from rectified top view images and compared with the inventory of the Research Platform Ödenwinkel. First results indicated a peak in lichen occurrence at intermediate ages of deglaciation (77-92 yrs). In this area, terricolous lichens clearly dominate and show the highest coverage (c. 36%). We found pronounced differences in species composition among the plots that might be explained by varying abiotic factors and competition with other taxonomic groups.

Mareike Mittag
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Robert R. Junker, Ulrike Ruprecht

LTLDE: LONG TERM LICHEN DIVERSITY EXPERIMENT. MYCO-, PHOTOBIONT AND MICROBIOME ASSOCIATIONS

One of the few organisms that are capable of surviving in extreme environments and are present all over the world are lichens. Containing a variety of fungal, algal, and bacterial communities, lichens form a miniature ecosystem. The two main symbiotic partners (mycobiont/fungus and photobiont/green algae or cyanobacteria) and the associated bacterial communities vary independently of each other along environmental gradients. In order to understand the adaptation mechanisms in lichens along climatic gradients, it is necessary to study the composition of the dominant symbiotic partners and the associated microbiome. Due to the negative correlation of mean annual temperature with elevation, elevational gradients are useful as a proxy for climate warming.
The long-term project "LTLDE: Long Term Lichen Diversity Experiment" started in 2017 with the aim of monitoring succession processes and recolonization of lichen-associated organism groups on an annual basis. This involved comprehensive molecular evaluations of the diversity of 103 lichen samples at T0 - the project's start date - collected at three sites along an altitudinal gradient on the Grossglockner High Alpine Road, Austria, as a function of altitude and time. The LTLDE project is designed to last ten years, with the community composition evaluated annually. This Master's thesis is part of the initial survey of all lichens present at the observation sites and provides the baseline data to follow the succession process. In addition, an analysis of the species composition of myco- and photobionts and the associated microbiome of crustose lichens on rocks was conducted using molecular methods. This allows an assessment of the variability of symbiotic partner associations along the gradient and interactions between different lichen species growing side by side on a rock. Looking at community composition of saxicolous lichens, we aim to answer the following questions. (i) Do the symbiotic partners of lichens - myco-, photobionts, bacterial microbiome - change along an altitudinal gradient? (ii) and how does diversity differ at a sampling site? (iii) Do neighbouring lichens share resident, available symbiotic partners - mycobionts, photobionts, and the microbiome?

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Birgit Oelschlägel, Hafez Mahfoud, Torsten Wenke, Katharina Rabitsch, Daniele Buono, Stefan Schulz, Regina Berjano, R. Henry L. Disney, Andreas Stark, Christoph Neinhuis, Stefan Wanke, Stefan Dötterl

IS THERE SEXUAL-DECEPTION IN MEDITERRANEAN *ARISTOLOCHIA*?

Deceptive flowers trick pollinators into visiting them by advertising a reward, which they do not provide. Numerous deceptive plants are pollinated by Diptera and rely on floral scent for attracting these insects. Apart from sapromyiophilous pollination systems, the chemical ecology of such interactions remains largely unstudied. This is also true for *Aristolochia* (Aristolochiaceae). To resolve the deceptive strategies of seven Mediterranean *Aristolochia* species, we identified pollinators and applied chemical-analytical methods, chemical synthesis, electroantennography, and behavioural assays. We showed that pollinating fly families (Phoridae, Drosophilidae, Chloropidae) and floral scents (typically consisting of only few compounds) strongly differ among the studied species. In this talk I discuss our analyses of *A. lutea* and *A. paucinervis*, both exclusively pollinated by male phorid flies, and suggest sexual deception as a deceptive strategy. The flowers produce aliphatic alcohols and ketones rarely found in floral scents, which we subsequently also detected in scents of female, but not male phorids flies. This would be the first case of sexual deception by chemical mimicry of fly pheromones outside of orchids.

Teresa Baumgartl
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Stefan Dötterl, Roman Fuchs

SPECIES AND HOST EFFECTS ON FLORAL SCENTS IN PARASITIC VISCUM AND THEIR DETECTION BY HONEY BEES

This thesis deals with the floral scent of *Viscum* species that grow parasitic on different host trees. Although *Viscum* is being intensively researched in cancer therapy it is the fruits that are being investigated. However, there have been no research approaches on the flower scent so far.
This study investigates which aromatic substances are present in the floral scent of four different *Viscum* species, in what quantity they occur and whether there is a difference between the scent of male and female flowers. Furthermore, this study analyses whether the floral scent of the species *V. album* L. subsp. *album* differs in relation to seven various host trees. In addition, EDA measurements are made on *Apis mellifera* to determine which scents they can sense.
The sampling took place in February 2022 in Arlesheim (Switzerland) on the area of Institut Hiscia. Five female and five male samples as well as control samples were taken per *Viscum* species and host tree and the scents were sucked into a filter tube by a vacuum pump. The samples were then analysed using gas chromatography and mass spectrometry.
This research was able to detect certain substances in the floral scent of *Viscum* for the first time and shows that *Apis mellifera* reacts to some of these substances.

Gladys Nyakeru Kung'u
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Jan Christian Habel, Beate Apfelbeck

EFFECT OF HUMAN ACTIVITIES ON VEGETATION STRUCTURE AND ARTHROPOD AVAILABILITY IN A KENYAN CLOUD FOREST: IMPLICATIONS FOR INSECTIVOROUS BIRDS

Land use change poses the main threat to forested ecosystem and species dependent on them. In addition, it has recently become evident that the ongoing degradation of the remaining primary forests will magnify species loss, especially for highly specialized fauna with little mobility. Identifying drivers of forest degradation is fundamental for guiding forest management and conserving threatened forest species. The present study had three objectives: (i) identifying factors that best explain variation in vegetation structure in the cloud forest fragments of the Taita Hills, (ii) examining the influence of degraded vegetation structure on arthropod abundance and diversity and (iii) discussing the implications of vegetation structure degradation and altered arthropod availability on insectivorous birds and recommending conservation solutions. We found that human activities at the landscape and plot level were important predictors of variation in vegetation structure in the Taita Hills forest fragments. Our results also show a relationship between multi-layered vegetation stands and canopy cover on arthropod abundance. Thus, exploitation of forest resources in a manner that distorts the vegetation layering may affect arthropod availability for insectivorous birds.

Sommer Anna
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Jana Petermann, Jonas Eberle

AQUATIC COMMUNITIES IN URBAN MICRO-ECOSYSTEMS

As a consequence of human population growth, people are increasingly living in cities, resulting in increased soil sealing, a higher density of buildings and rising temperatures. An important aspect in urban ecology is to protect biodiversity, to maintain resilient ecosystems and to fulfil human needs. Small aquatic systems such as water-filled tree holes and man-made containers harbor a variety of invertebrate species but may be affected by human activities. Generally, small waterbodies in urban environments are underrepresented in research but relevant, for example, as breeding grounds for disease-carrying species like mosquitoes.
In this project, I investigate (1) if invertebrate communities (abundance, species richness and community composition) in urban aquatic microhabitats are affected by urbanization with respect to different urbanization measures like soil sealing, building-density and -height or altered land use types between the city center and outskirts. Additionally, I examine (2) if and how urbanization affects leaf litter decomposition by invertebrates and mosquito production in aquatic microhabitats. First results show species shifts between urban and more natural areas. More detailed results provide novel insights of spatial effects on aquatic insects and can help to understand complex species dynamics in urban space and how to avoid the possible spread of nuisances or pests such as adventive mosquito species.

Florian Hohenberger
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Stephen Wickham, Ulrike Berninger

PHYTOPLANKTON COMMUNITIES IN HIGH ALPINE LAKES OF THE NATIONAL PARK HOHE TAUERN

Phytoplankton communities in high alpine lakes are a highly interesting topic. Located in extreme environment the species must be adopted to short growing phases in summer and long winters with ice covered surface. Expanding the time of growth in summer due to climate change can lead to differences in species composition. This change in vegetation period through earlier ice out can also influence mixing regimes, which can also chance species composition (Rühland, et al., 2015). This study tried to document the species and their abundance in 18 lakes of the National Park Hohe Tauern located between 2000 and 2600 m a.s.l. over a period of three years (2018-2020) and compare these data to abiotic measurements over a period of six years(2017-2022). The presence of species seems to be determined to certain lakes although the abundance in different years alters a lot. The vegetation time between sampling and the melting of the ice cover of these lakes seem to be the driving force of species richness, which is low in general. Elevation and other abiotic factors like nitrogen are important for algae growth but don’t have a strong effect on species composition.

Dominik Hagen
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QUANTITATIVE INVESTIGATION OF DIATOM DISPERSION IN LUNG TISSUE OF CONFIRMED DROWNING INCIDENTS

A reliable identification of death by drowning is still a delicate issue in forensic science, especially when typical autopsy findings (drowning signs) are absent. In such cases, evidence can still be provided by examining internal organs for diatoms with a modified SEM-based diatom testing technique. This method compares the diatom concentrations of lung tissue and the corresponding drowning medium to final conclude an L/D value for possible drowning confirmation. For previous case studies, lung tissue samples were taken from the upper left tip of the lung, the area of lowest inhalation pressure, due to the assumption that the probability of a drowning event was highest, if diatoms were present there. However, it remains unclear whether different parts of lung tissue would display different diatom concentrations. To investigate regional differences in general, and to determine which part of lung tissue is best qualified for valid results, we compared the diatom ratio of multiple sampling sites within the lungs. In detail, we examined seven different regions allocated across both pulmonary lobes of three confirmed drowning cases to obtain a broader understanding of the mechanisms of diatom inhalation.

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Hubert Kerschbaum, Hans-Christoph Nuerk

CONSEQUENCES OF ENVIRONMENTAL NOISE ON COGNITIVE PERFORMANCE, USING A TWO-DIGIT NUMBER COMPARISON PARADIGM

Anthropogenic noise, like construction or traffic noise, have deleterious consequences on human health. In the present study, we compare the impact of environmental soundscape on human cognitive performance, using a two-digit number comparison paradigm. Performance in the two-digit number comparison task will be quantified in the presence of natural and anthropogenic background noises. In addition to quantifying error rates and response times, we will study the impact of noise on the brain while comparing numbers using fMRI and on the endocrine system by measuring the stress hormone, cortisol.

Invited Guest Speaker

Ulrike Aspöck
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THE NEUROPTERIDA (INSECTA: HOLOMETABOLA) – CATALYST FOR UNDERSTANDING THE EVOLUTION AND THE UNIVERSE.
A HEURISTIC CONTRADICTION?

The Neuropterida with about 6.500 species comprise three orders: Raphidioptera (ca. 250 species in two families) which are the sistergroup of Megaloptera (ca. 400 species in two families) + Neuroptera (ca. 5.900 species in seventeen families). They represent a fascinating lingering diversity of bygone blossom. The terrestrial larvae of Raphidioptera and the aquatic larvae of Megaloptera have chewing mouthparts, the larvae of the Neuroptera have sucking tubes, which represent a spectacular synapomorphy.

The KT impact caused by an asteroid 66 million years ago extinguished – among others – the Dinosaurs and – fortunately only almost – the Raphidioptera.
Three selected conundrums instead of seventeen stories will be discussed: Ocelli of Osmylidae – a reexpression? Cryptonephry – how many times invented? Eyespots – to frighten whom?

Our expeditions always became adventures in deserts, mountain ranges and rain forests around the globe.

Barbara Stockl
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Jan Christian Habel

COMMUNITY COMPOSITION OF AFRICAN BUTTERFLIES IN ETHIOPIAN FORESTS

In recent decades, a steady decline of forest and bushland has been recorded in Ethiopia. This can primarily be assigned to agricultural use, which is associated with the growing population. Today, we are faced with fragmented small patchy forest areas surrounded by cultivated land. The patches are mainly church forests which are remaining to the former forest areas. These sacred forests are key factors for the preservation of biodiversity. As butterflies respond sensitive to habitat and ecosystem changes, the upcoming study aims to assess the species composition of such forests. Moreover, we want to find out how the forest community differs from the surrounding areas. The study area covers the Tara Gedam church forest in northern Ethiopia. The method of transect counts and bait trapping should result in a better understanding of the species community. Transect counts are used to record species close to the ground and shrubs, while bait trapping is used to record highly mobile species in the canopy. Together, these two methods will provide a comprehensive portrait of the butterflies in the Tara Gedam church forest.

Andrea Rimböck
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TO BEE OR NOT TO BEE - HOW LAND-USE AND LAND-RESTORATION AFFECT LOCAL WILD BEE DIVERSITY

Extensive temperate grasslands found in Europe are considered to be among the species richest habitats in the world, but are threatened by land-use change and fragmentation, which are both thought to be main drivers of extinction. These processes are also affecting the bee diversity. Central Europe exhibits nearly 600 solitary bee species, 10% of which are building their nests into reeds and other hollow stems. These species are common in popular “insect hotels” and other artificial nesting aids, and they make-up a community of bees that can be used to analyze parameters of species richness, ecological interactions in the landscape. Sampling from artificial nesting aids set up at over 30 restored and unrestored grassland sites near the city of Salzburg, we investigate the diversity of bees hatched from the nesting aids and whether or not renaturation has an effect their community. Preliminary findings identified 15 species thus far, including 8 bee species and 7 parasitic wasp and fly species, whose abundances and species richness were found to be higher at restored sites than at unrestored sites. This study outlines the positive effects that habitat restoration towards extensive, species-rich grasslands has on bee diversity.

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EFFECTS OF EARLY SPRING GRAZING AND MOWING ON FLORA AND FAUNA IN GRASSLAND ECOSYSTEMS: A TRAIT-BASED ANALYSIS

Due to the ongoing decline of biodiversity, the Natura2000 network was established three decades ago to halt further losses of biodiversity-rich habitats across the European Union. Despite the efforts, many of the protected habitats are still declining. Therefore, it is of utmost importance to ensure conservational activities efficiently maintain high habitat quality. Seasonal changes due to climate change as well as eutrophication call for novel conservational management approaches. This is the case especially for anthropogenic habitats such as extensive meadows and pastures. One possible management approach to increase or maintain habitat quality of pastures and meadows is an additional mowing or grazing event in early spring, also referred to as “pre-utilisation”. To assess the effects of pre-utilisation on characteristic flora and fauna, we introduced a measure of species sensitivity using phenological and biological trait data. First results suggest early spring grazing or mowing to be less detrimental to flora and fauna compared to currently applied utilisation dates. Our study may ultimately guide future field tests assessing the effects of novel management regimes on specific habitat types.

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MODELING CHEETAH *(Acinonyx jubatus)* DISTRIBUTION BEFORE AND AFTER MAJOR HABITAT MODIFICATION IN NORTHERN AND SOUTHERN KENYA

Majority of Kenya's cheetah population occurs outside protected areas. However, there is limited information on cheetah resource use in landscapes where they co-occur with humans. In this study, we test how a combination of environmental, anthropogenic and biotic-spatial covariates influence cheetah habitat use before and after major habitat modification in the Salama/ Athi Kapiti area in southern Kenya. This area has undergone major changes in land tenure, policy and infrastructure development which have modified the landscape. Changes modeled in the Salama/ Athi Kapiti study area will then be used to infer future changes that are likely to occur in the Samburu/ Isiolo ecosystem in northern Kenya after the completion of a major infrastructural development project (LAPSSET) which is expected to cause major land use changes.

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MONITORING, CONSERVATION MEASURES AND POPULATION GENETIC ANALYSES OF A SMALL *BOMBINA VARIEGATA* POPULATION IN OHLSDORF (UPPER AUSTRIA)

Habitat loss and fragmentation are leading to strong decreases of local populations of the strictly protected Yellow-bellied toad (*Bombina variegata*). In 2021, a small and probably isolated population was discovered in a Natura 2000 protected area in Ohlsdorf (Upper Austria). Microsatellite analysis should answer the question if this population is in fact isolated and shows a reduced genetic diversity.
A monitoring project will provide further insight into size, age structure and sex ratio of this population. Based on a habitat evaluation we will elaborate a management plan in cooperation with the conservation department of the government of Upper Austria which includes the construction of additional spawning sites to support the local population and facilitate a reconnection to neighbouring populations.

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Ao.Univ.Prof.Mag. Andreas Weixler, Assoc. Prof. Dr. Jana Petermann

ECOACOUSTIC RESEARCH AND ITS EXPRESSION THROUGH SONIC INTERMEDIA - SPECIES EXTINCTION IN NATURAL SPACES AND ECOACOUSTIC COMPOSITION

This dissertation deals with ecological sound art, and electroacoustic composition and investigates the relationship between soundscape diversity and biodiversity with regard to urgent ecological issues. The objective is to measure and compare the presence of anthrophonies and biodiversity in two Austrian national parks with adjacent human-altered landscapes. The aim is to make auditory and non-auditory patterns and ecological issues of a landscape scientifically and artistically presentable.
There is a lack of effective communication of ecological findings to the public. The main intention of this dissertation is the artistic approach to process ecoacoustic findings in a sonic intermedia artwork and to gain new perspectives on musical properties in composition inspired by ecological artistic research.
The first research question explores how sound recordings can be used to capture anthropogenic influences on ecosystems and ecological diversity. The main research question aims to develop meaningful compositional strategies to represent soundscape quality, habitat ambience and the spatio- and spectro-temporal dynamics of acoustic communities.