Suggestions of thesis projects in Environmental Sciences/
Förslag på examensarbete inom miljövetenskap

The thesis projects list was updated March 2023 with suggestions made by Dept. of Biological and Environmental Sciences, GGBC, Lilla Edets municipality, and compiled by Annemieke Gärdenäs. It is not a complete list of all student projects available at the departments of **Biological and Environmental Sciences (BioEnv), Earth Sciences, Chemistry and molecular biology,** and **Marine Sciences,** see also the respective webpages (some are given below) for more suggestions and contact information.

English
This catalogue contains suggestions of topics for degree projects at both Bachelor's and Master's degree levels. We present first, projects related to various scientific disciplines (Biology, Chemistry, Earth Sciences, etc.) and research groups that conduct studies in the field of Environmental Science. If you find a project that interests you, please inform the supervisor for that project by e-mail of your interest and background and eventually arrange a meeting.

Some projects will be carried out at external organizations such as the Gothenburg Environmental Administration (City of Gothenburg) and Lilla Edets municipality. Also here, you contact the supervisor of the project of your interest. Please note that for **all external projects (outside University of Gothenburg), an internal supervisor has to be appointed**. In many cases, such supervisors are indicated in the adverts below, but if not, you are expected to be active in finding an internal supervisor that is willing to take on the task! In case, you are not successful, the course leaders can help you to find a suitable supervisor at the University of Gothenburg.

You can find more information about the degree projects here
https://studentportal.gu.se/english/my-studies/bioenv/degree-projects

And here https://studentportal.gu.se/english/my-studies/bioenv/student-in-environmental-sciences/degree-projects

Svenska
Nedan presenteras förslag på olika ämnen för examensprojekt på såväl kandidat- som masterexamensnivå. Först presenteras projekt som är knutna till olika basämnen (biologi, kemi, geovetenskaper etc) och forskargrupper som bedriver forskning inom området miljövetenskap. Finner du något intressant projekt kontaktar du kontaktpersonen för respektive projekt för samtal och eventuellt möte.

I slutet presenteras projekt från Göteborgs stads Miljöförvaltning. Även här kontaktar du kontaktpersonen för respektive projekt. När det gäller projekt som genomförs utanför Göteborgs universitet (t.ex. Göteborgs stads Miljöförvaltning och Lilla Edets kommun) skall du även ha en handledare vid universitetet. Försök hitta en lämplig och om du inte lyckas, hjälper kursledarna dig med att hitta en lämplig handledare vid Göteborgs universitet.

Du hittar mer information om examensarbeten här
https://studentportal.gu.se/minastudier/bioenv/examenskurser

https://studentportal.gu.se/minastudier/bioenv/student-i-miljovetenskap/examensarbete

Table of contents of Catalogue Suggestions of topics listed according to main focus

Contents

1. Atmospheric science

Atmospheric science covers a wide range of research topics, all connected to the atmosphere in one way or another. Topics include, but are not limited to, how fundamentalatmospheric chemistry and atmospheric physics affect ecosystems, air quality, health, and climate. Atmospheric science research is important to understanding many of the challenges that concern sustainable agriculture, our health, the use of fossil fuel-based energy, the development of urban environments, our ecosystems and our climate.Atmospheric science research is also linked to many of the UN's global sustainability goals.

We offer thesis projects in the fields of

- Emission measurements from various transportation means
- Secondary organic aerosols (SOA)
- Air quality in urban areas in low and middle income countries
- Trace element analysis
- Short lived climate forcers
- Aerosol – cloud – climate interactions
- Fossil- or biomass- based combustion processes
- Ice nucleation and cloud formation
- Development of analytical techniques
- Aerosol surface chemistry
- ….. and related fields

Come talk to us! We are open for discussions of your own project ideas, or clarificationsof the above topics! For more information and contact details, please check out our homepage: Atmospheric science

Students who have pursued thesis projects and graduate work within Atmospheric Science have gone on to use their knowledge and skills in careers with environmental and regulatory agencies (RISE, VTI, etc.) and a wide range of private industry (Volvo, IVL, etc.).

Contact persons: Xiangrui Kong, kongx@chem.gu.se; Erik Thomson, erik.thomson@chem.gu.se and Mattias Hallquist, mattias.hallquist@gu.se.

Chemical mapping of atmospheric aerosol particles (BSc or MSc)

Objective of the project

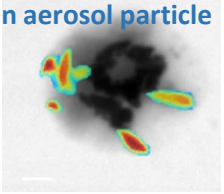
The objective of this project is to understand the transformation and ageing mechanismsfrom primary dust storm particles to secondary aerosol particles. This process is very important for air quality and climate, but the knowledge is still very limited. The synchrotron-based chemical mapping results will enable us to visualize the ageing stagesand mixing states, which will shed light on the transformation and ageing mechanism of aerosol particles.

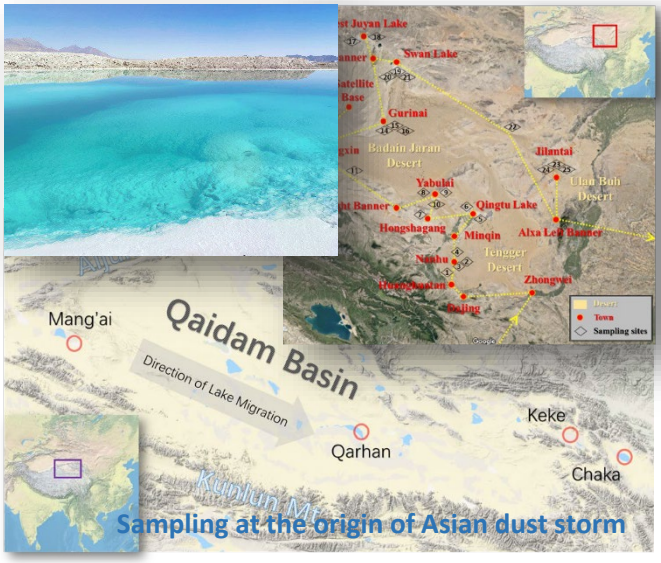
Scientific background

Asian dust storms, carrying tons of mineral particles from arid and semi-arid areas such as Mongolia and northern China eastward over eastern China, the Yellow Sea, the

Korean Peninsula, Japan, and the Pacific Ocean, have long been an issue affecting globalbiogeochemical cycles and climate. Due to climatic anomaly in the dustsource areas and strong Mongoliancyclones, the dust storms originatedfrom Mongolia intensely staged a comeback during March to May 2021 after decades of deceleration.Heavy air pollution, *i.e.*, haze, occurred frequently in the spring of the East Asia. Mineral particles are known to actively provide interface for condensation and reaction of air pollutants during transport and theyhave been reported to possess better chance to mix with local anthropogenic emissions when passing through longer distance after the ecological restoration policies. The formation of secondary coatings on dust particles significantly contributes to the optical, chemical, and hygroscopic modification of Asian dust, causing critical concernin atmospheric environment and public health, which in turn, makes it important to precisely characterize the chemical compositions of the mixture particles.

Chemical mapping of an aerosol particle





For the detailed characterization of the complex mixtures of atmospherically processed dust particles and to explore the secondary formation mechanisms of the coatings on dustparticles, some advanced microbeam analytical techniques will be used to provide spatially resolved information, e.g., Scanning/Transmission Electron Microscopy-Energy-dispersive X-ray spectroscopy (SEM/TEM-EDX), Nanometer-scale Secondary Ion MassSpectrometer (NanoSIMS) provide information on the size and elemental compositions of individual particles with submicrometer lateral resolution. Although very powerful, the above techniques have limited capabilities when performing molecular speciation of particles. In this project, the synchrotron-based Scanning Transmission X-ray Microscopy(STXM) will be utilized to detect elemental and functional group composition and mixing state in individual aged dust particles. The STXM results are expected to shed light on the mixing state of primary dust particles and secondary aerosol particles. So that the combination of the techniques can provide unambiguous chemical and structural information on heterogeneous dust particles. The thesis project student will learn and understand the principle of the synchrotron-based STXM method, and analyze the STXMdata on the fresh and aged aerosol particles.

Contact: Xiangrui Kong (kongx@chem.gu.se)

We have continuously other interesting project opportunities, so please just contact us if you are interested in atmospheric science.

2. Biology

Evolutionary ecology of variable natural selection

Luc Bussière research group

Our research group examines the evolutionary consequences of variable natural and sexual selection, and its role in shaping diversity in expensive traits, including those involved in sexual attraction and pathogen defence. We try to explain a) why there is so much genetic variation for these characters despite the strong selection acting on them; b) how we can exploit these phenomena to create more sustainable pest control; and c) what factors might most affect the recovery of at-risk species facing newand variable pressures in threatened habitats. I invite interested students to contact me so that we can explore together the topics that most interest them. Two examples of projects are given below to provide a flavour of our research.

Example project 1: ***How diverse biological control can sustain genetic variation for susceptibility*** (a range of projects are suitable for either Bachelors and Masters students)

Despite extensive research on insecticide application regimes, insecticidal compounds and geneticallymodified crops, insects continue to evolve resistance against control agents with predictable regularity. This resistance presents a substantial threat to livelihoods and food security, but also to environmental health, not least because current resistance management approaches emphasise eradication of resistance alleles using high doses of synthetic insecticides. Biopesticides that enlist living organisms in the fight against insect pests offer a promising and more sustainable alternative to chemical insecticides,but their potential to excite resistance has been underappreciated. We have found consistently high levels of quantitative genetic variation for resistance to biopesticide fungi that kill herbivorous insects.

We have further shown that this variation is strain- and context-specific, such that the resistance genotypes depend sharply on environmental variation. We work with partners in the United Kingdom, Brazil and Kenya to explore how these factors might be implemented to promote pest management thatis both ecologically and evolutionarily sustainable. For polyphagous pests (with very broad diets), host plant changes represent an obvious dimension of environmental complexity which we have shown can generate fluctuating selection on pests (see Fig. 1). However, it is still unclear how other biologically complex aspects of the environment (such as predators and parasitoids) can affect selection for fungal resistance. One possible project therefore involves assessing survival for family lineages of moths that have been alternately exposed to control conditions, fungal biopesticides, and biocontrol predators and/or parasitoids.

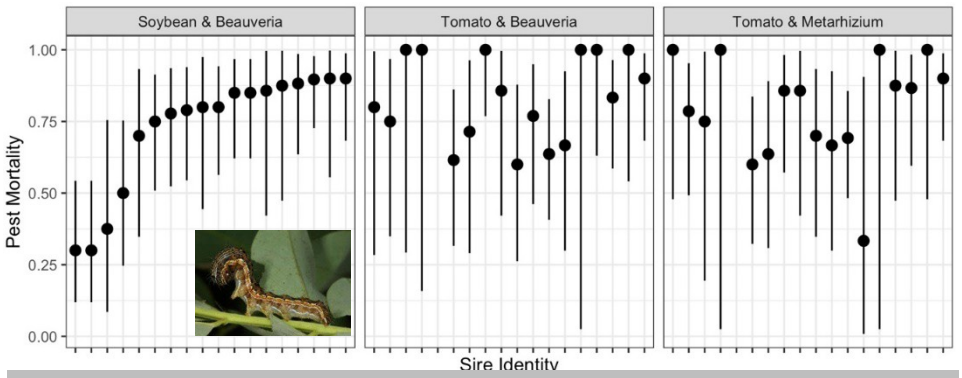


Fig. 1. Mortality (and 95% binomial CI) of *H. armigera* larvae (pictured in inset of the left-hand panel) as a function of sire identity; the order of sires is the same across all three panels. Although susceptibility to fungus is generally high (with mortalities mostly above 75%), offspring from some sires fare much better, indicating genetic variation for resistance. At the same time, the fact that sire performance depends on host crop and fungal isolate (across the three panels) indicates strain specificity and strong genotype-by-environment interactions.

The candidate will work with an international network of scientists studying evolutionarily sustainable pest control, and will receive training in insect husbandry, microbial control bioassays, the generation of half-sibling lineages, quantitative genetics methods,and advanced mixed modelling implemented in R.

If you are an enthusiastic student interested in developing a BSc or MSc project with us get in touch: **Luc Bussière** **luc.bussiere@bioenv.gu.se**

Phycology

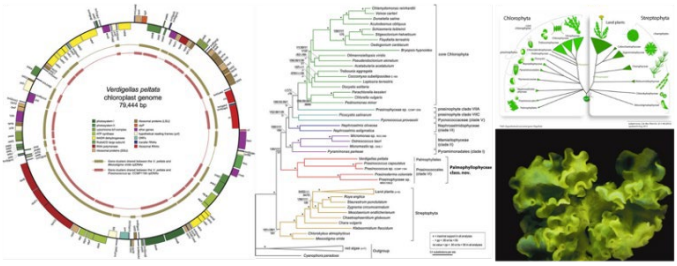
Research projects at the Phycology lab cover the areas of **algal biodiversity**, **evolution** and **genomics**. We address questions ranging from patterns of diversification and speciation in algaeto the role of **secondary metabolites** in **algal overgrowth of corals** and their **bioactivity**. We are particularly interested in studying phenomena of **tropicalization**, currently taking place in more temperate regions that may serve as natural laboratories to detect and predict changes in marine ecosystems in future climate scenarios. To this end, we are developing an integrative approach to forecast **cyanobacterial harmful algal blooms** and changes in **toxin production** related to anthropogenic environmental effects. See below a graphic summary of the lab's research areas.

As a student in our lab you can expect to be involved in field and lab work, and to get hands-on experience on a variety of methodologies including genetics, genomics, bioinformatics, chemical profiling, culturing and morphometrics.

If you are an enthusiastic student interested in developing a BSc or MSc project with us get in touch: **ana.tronholm@bioenv.gu.se**

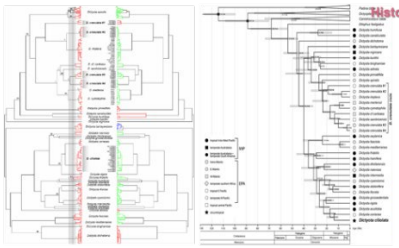
Algal genomics

GrATeL
Assembling the Green Algal Tree of Life



Deepest-branching lineage of green algae

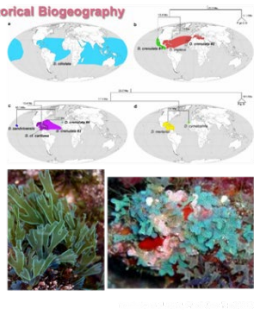
Algal Systematics, Evolution and Biogeography



Species delimitation

Origin and diversification

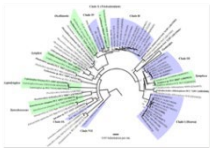
Historical Biogeography

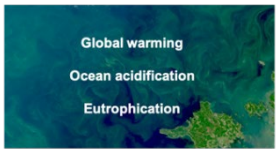


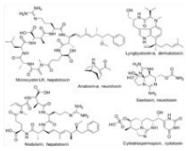
Harmful Algal Blooms

FORMAS

Development of an innovative and integrative method for forecasting toxic cyanobacteria in a changing environment

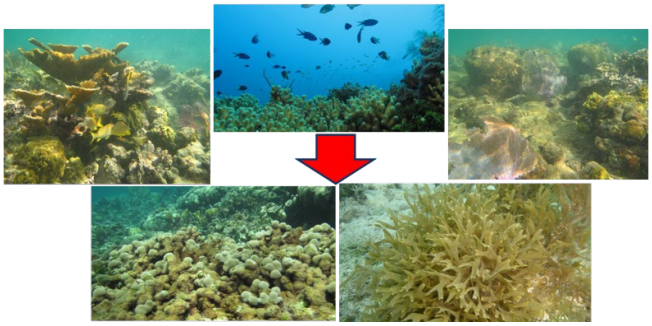






http://proj.formas.se/detail.asp?arendeid=10820&x=250&y=20&sprak=1&redovisning=0
https://www.oceancommunitychallenge.com/post/the-killer-algae-challenge
https://www.facebook.com/algalbloomssweden/

Algal – coral interactions



Evolution of gametes and reproductive traits in marine organisms

Projects can be designed for both bachelor and master's level

Contact: Erica Leder (erica.leder@gu.se)

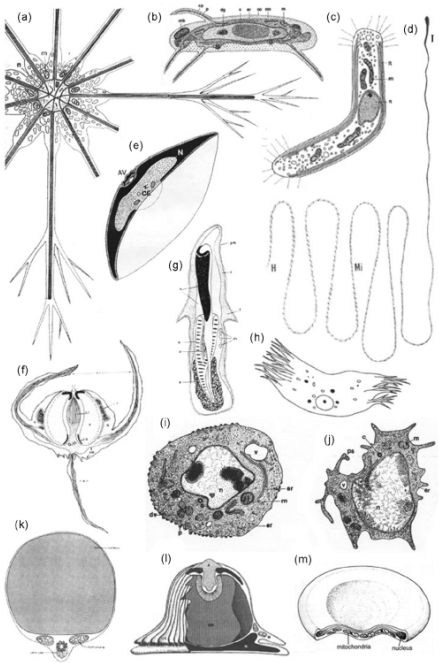
I am an evolutionary geneticist with broad interests in the evolution of phenotypes, particularly with respect to reproduction and mating systems; however, the projects need not involve genetics. Additionally, depending on the taxa and the approach used, other co-supervisors will be involved. Projects will be based mostly at the marine station in Tjärnö, but if there is a co-supervisor in Gothenburg or Kristineberg, the project may take place there.

Background

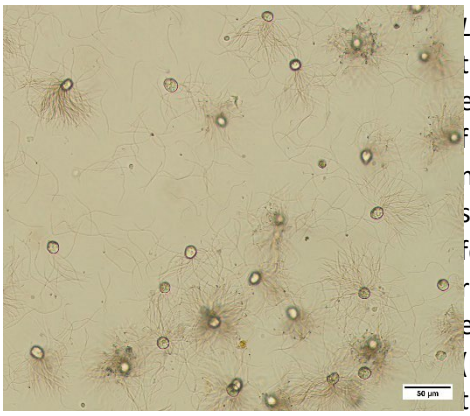
Sperm cells are one of the most varied cell types acrossthe animal kingdom which is surprising giving their universal function of fertilization of an egg. Many organisms, especially crustaceans, have vastly differentmorphology than what we typically think of as a spermcell – the tadpolelike mammalian sperm (in the figure, a-d and h-j are crustaceans, from Pitnick et al. 2009).

Additionally, in the marine environment, many organisms have external fertilization, so the gametes can be affected by the external environment (salinity, pH, pollutants). Sperm are produced in the testes through the process of spermatogenesis, and germ cells proceed through several sequential steps before becoming a functional sperm cell. Due to the complexity of varied cell types that are present in testistissue, very little is known about the cell biology and genetics of this process except in model organisms.

There are many interesting questions still to be addressed concerning spermatogenesis and sperm evolution in fish and marine invertebrates.



In my lab, we currently work on *Littorina* snails (picture on the right: *Littorina fabalis*). At the Swedish West coast, there are four species from the genus *Littorina*. Two of these species have different ecotypes which are adapted to specific habitats. Even though the ecotypes are found in close proximity, they are genetically different suggesting reproductive isolation. Thus, *Littorina* snails provide an interesting system to study the mechanisms of reproductive isolation and speciation. We are interested in the mating behaviour, sperm competition and mechanismsthat are resulting in reproductive isolation.



Littorina snails also show a unique sperm biology. They have two different types of sperm: the typical sperm called eusperm and a non-fertilizing cell called parasperm, whose function is yet unknown. *Littorina* females mate with several males and can store sperm for a long time, which means that sperm competition (when sperm cells compete for the fertilization of an egg) is an important mechanism in the reproduction of theseanimals. In the image on the left, most eusperm (thread-like structures) are attached to a parasperm (round cells). However,during mating there is evidence that the eusperm detach from the parasperm, and parasperm do not enter into the female reproductive tract. We wish to explore this in more detail to discover the function of parasperm in thesetaxa.

Potential Student Projects

A project with a lot of practical work would be to investigate methods for rearing *Littorina fabalis*- a species with two ecotypes. So far, we have not reared this species in the lab. This would include sampling the snails in the wild and trying out existing methods for other *Littorina* snails, so that we can get *Littorina fabalis* to breed in captivity. The developed method would be very useful for future studies,regarding investigating their mating behaviour, female sperm storage etc.

Another project would be studying sperm competition in the snails. Female *Littorina* snails can store sperm, and so potentially choose which sperm is used for the fertilization of her eggs. The student would study the mating behaviour of the animals. In *Littorina saxatilis* and *Littorina obtusata*, we know that the female will mate with many males and a brood can have multiple fathers, but this still needs tobe tested for other species and under stressful conditions. The project could include studying the orderin which females mate with their mates and how this affects the number of their offspring, or how mating may be affected by high temperatures. This could also be an interesting contribution to the study of cryptic female choice, which describes a post-copulatory mate choice mechanism. If a master'sproject is desired, a genetic component here would be a nice option to understand how many fathers contribute to a brood.

Another project would be comparative morphometrics of the eu- and parasperm where the students would measure the size of sperm cells in different species and ecotypes. The focus of the project can bedecided together with the student, e.g. only measuring eu- or parasperm; measuring the ratio of one cell type to the other, testing different preservation methods etc.

Students could also work on histology, i.e. investigating reproductive tissue of the snails with focus onthe eu- and paraspermatogenesis (= process of sperm cell development).

Projects are also not limited to the above projects. If you have ideas that fit within the broad area of reproductive biology in marine organisms, please contact me to discuss a project.

To summarize, the students can work on a variety of projects in my lab, from cell biology, histology to developing rearing protocols and conducting behavioural studies. In all these projects, they will learn techniques such as dissection of small tissues, histology, microscopy, using image analysis software etc.,which all will be useful for their future career. Additionally, if a longer project is desired (i.e. master's project), a molecular part can be used to address these questions (such as genetics or proteomic analyses).

Novel techniques for sustainable food production through aquaculture

Traditional aquaculture consist of open-cages, with potential negative impact on the environment. Recirculating aquaculture systems (RAS) offer the possibility to achieve a high production with minimal ecological impact, and therefore are of interest to develop a sustainable aquaculture in Sweden. A currentdownside of RAS is the production and accumulation of various waste, which may negatively affect the welfare of the fish, if not well managed. RAS are pretty diverse and use a series of different treatment processes to maintain water quality and limit water exchanges. In biofilters, ammonium is converted to nitrate, via nitrite through the action of nitrifying bacterias. Nitrate can later be removed by either denitrifying bacterias or water exchanges. Recent studies have shown potential of alternative sources (macro and micro-algae, membranes, *annamox*) to mitigate environmental problems of aquaculture as efficient biofilters. In addition to those dissolved waste, solid waste must be also treated adequately in RAS in order to avoid unwanted bacterial growth and diseases outbreaks. Concentrating those solids wastes into sludge could latter lead to the valuable new resources.

The aim of current project is to conduce a literature study in order to compile and compare the new advances in RAS research that would help lowering even more the environmental footprint of those systems.

Contact persons: Jonathan Roques (jonathan.roques@bioenv.gu.se) or Kristina Sundell (Kristina.sundell@bioenv.gu.se).

Ecology and ecophysiology of microbenthic and planktonic communities

Focus on Impacts of UV-radiation, climate change
Contact person: Angela Wulff. angela.wulff@bioenv.gu.sewww.bioenv.gu.se/personal/Angela_Wulff



Impacts of ocean acidification on marine species and ecosystems

My laboratory, based at the Sven Lovén Centre for Marine Infrastructure – Kristineberg, investigate the impact of global changes on marine species and ecosystems. We aim at better understand future environmental changes to be able to inform managers and policy makers.

The ocean provides a vital benefit to human society by absorbing one-fourth of all man-made carbon dioxide (CO_2) released into the atmosphere, thus substantially limiting climate change. However, oceanic CO_2 uptake comes with a cost. Known as the 'other CO2 problem', ocean acidification is a new and emerging challenge for sustainable development and ocean governance. In short, the term describes a series of chemical changes occurring when atmospheric CO_2 dissolves in seawater, with potentially dire consequences for marine organisms,ecosystems and the services they provide. Over the last 15 years, we have been studying the consequences of this **ocean acidification** including questions such as:

- ✓ How can we identify winners and losers? What species are able to cope with ocean acidification and what species are likely to be negatively impacted?
- ✓ What are the physiological mechanisms allowing acclimation to ocean acidification?
- ✓ What are the transgenerational effects of ocean acidification? Is there enough geneticvariability to adapt to the changes to come?
- ✓ How does ocean acidification interact with other environmental changes?
- ✓ What will be the consequences of ocean acidification on Swedish seafood?

Do not hesitate to contact me if you are interested in joining our team and develop a research project. **Contact person:** Sam Dupont, sam.dupont@bioenv.gu.se

Fish behaviour and welfare

My laboratory is interested in understanding the mechanisms underlying animal behaviour to address how physiology underpins behavioural responses and how external factors affect suchas climate change affect behavioural and physiological phenotype. My research also explores questions in applied welfare of aquatic animals to understand how the impact of procedures inaquaculture, the laboratory and in the ornamental industry affect fish. These projects are suitable for undergraduate and Masters students.

Projects are varied and include:

1. Welfare of fish using behavioural and physiological techniques
2. Neurobiology of processing external stimuli in larval zebrafish
3. Impact of pharmaceuticals on behaviour of anemones, crustaceans and fish
4. Impact of climate change on aquatic invertebrates and vertebrates





Contact person: Dr Lynne U. Sneddon lynne.sneddon@bioenv.gu.se

Fish eco-physiology

Our group's research addresses questions in eco-physiology and stress biology of fish, particularly as they relate to integrated cardiovascular and respiratory functions. We are broadly interested in how fish interact with their environment, and how they respond and acclimate to environmental (e.g. temperature, hypoxia and salinity) and man-made stressors(e.g. climate change, aquaculture-related).

We look for highly motivated students to take on research projects as a masters or bachelors thesis. Most student projects involve animal experimentation and you will receive training in various advanced surgical and in vivo experimental techniques. Experimental work is performedat the Department of Biological and Environmental Sciences (Zoology building, Medicinareberget). Your project will typically be performed and co-supervised within the framework of ongoing research projects of the groups' PhD students or post-docs. All projects, particularly those at MSc. level (45-60 hec), address novel and relevant questions at the forefront of fish eco-physiological and aquaculture research, and will be designed with the aim to provide data suitable for presentation at scientific conferences and publication in scientific journals.

Examples of current research themes

- Mechanisms of temperature tolerance and linkages to cardiorespiratory and neuralfunctions
- Cardiorespiratory interactions and metabolic plasticity to aquatic warming and hypoxia
- Role of cardiovascular and metabolic adjustments in osmoregulation and salinitytolerance
- Stress biology and welfare of fish in aquaculture

Please contact Professor Erik Sandblom (Dept. of Biological and Environmental Sciences, GU)for further information and to discuss currently available projects in the group.

Contact person: Erik Sandblom, erik.sandblom@bioenv.gu.se Phone: +(46) 703 286358,

The capacity of Swedish coastlands to store atmospheric CO2; three projects

A case study on "Nordic mangroves", our Swedish wetland forests

Project level: Master students and/or bachelor students

Contact persons: Maria Asplund, BioEnv, Göteborgs universitet, maria.asplund@gu.se, Mats Björk, DEEP, Stockholm universitet, mats.bjork@su.se, Martin Gullström, NMT, Södertörn Högskola, martin.gullstrom@sh.se

Main topic: Marine Ecology or Environmental studies

Project description: The vegetation of coastal ecosystems play an important role as efficient natural carbon sinks, reducing net greenhouse gas emissions. Our research aims to understand the carbon sink capacity and greenhouse gas balance to identify hotspots of carbon sequestration within the coastal seascape environment, and to understand the fate of stored carbon as potential sources for greenhouse gas emissions. This project focuses on coastal forests, inundated vegetated marine systems that has the capacity to store large amounts of carbon, but to date not properly evaluated along the Swedish coasts. The study includes field and experimental studies in coastal shallow-waters, with focus on *Alnus* and *Salix* covered habitats. The project aims to assess carbon stocks, carbon accumulation rates and greenhouse gas fluxes within different inundated forest habitats acting as natural carbon sink hotspots. The project has a wide approach and can include several different projects. Literature studies connected to the topic is also possible.

Photo: Maria Asplund

A case study on yellow water lily, "Gul näckros" *Nuphar lutea.*

Project level: Master students and/or bachelor students

Contact persons: Maria Asplund, BioEnv, Göteborgs universitet, maria.asplund@gu.se, Mats Björk, DEEP, Stockholm universitet, mats.bjork@su.se, Martin Gullström, NMT, Södertörn Högskola, martin.gullstrom@sh.se

Main topic: Marine Ecology or Environmental studies
Project description: Brackish water vegetation has been largely neglected concerning their role as carbon sinks within the coastal seascape environment, and detailed studies are necessary to understand their role as climate change mitigators. This project focuses on the common water lily *Nuphar lutea*, a common inhibiter of sheltered bays in the brackish waters of the Baltic seas. There this plant changes the system by covering the surface with shading leafs and growing extensive rhizome and root systems, potentially providing a large carbon storage capacity. The study includes field and experimental studies in coastal shallow-waters, and aims to assess carbon stocks, carbon accumulation rates and greenhouse gas fluxes within different water lily covered bays. The project has a wide approach and can include several different projects. Literature studies connected to the topic is also possible.

Photo: Maria Asplund

Blue carbon sink capacity in Swedish coastal seascapes
Project level: Master students and/or bachelor students
Contact persons: Maria Asplund, BioEnv, Göteborgs universitet, maria.asplund@gu.se, Mats Björk, DEEP, Stockholm universitet, mats.bjork@su.se, Martin Gullström, NMT, Södertörn Högskola, martin.gullstrom@sh.se

Main topic: Marine Ecology or Environmental studies
Project description: Global climate change mitigation through the preservation of natural carbon sinks is of vital importance to face the threats to our planet. It is thus crucial to conserve the ecosystems' ability to slow down the prevailing increase of atmospheric CO_2 and plan how our coasts are utilized in the best way. By failing to do so, large amounts of greenhouse gases will be released from disturbed biological carbon sinks. Our research aims to understand the carbon sink function and greenhouse gas exchange to identify hotspots of carbon sequestration within the coastal seascape environment, and to understand the fate of stored carbon as potential sources for greenhouse gas emissions. We assess climate change mitigation capacity of Swedish coastal seascapes by assessing blue carbon sequestration capacity, greenhouse gas exchange and seascape connectivity (export and fate of carbon) coupled to distribution of blue forest habitats and

contemporary land use. Using a broad landscape-scale perspective, we study interactions between different vegetative coastal blue forest habitats (on land and in shallow waters), the surrounding geomorphology and sedimentological properties, to understand carbon stock dynamics and essential climate change mitigation services of blue carbon sequestration.

Photos: Maria Asplund

3. Biology – focusing on ecotoxicology

Ecotoxicology - general

English

Never before has the usage of chemicals been larger than today, as is the case with use of fossil energy. Aquatic organisms is the focus of our ecotoxicological research, as the aquatic environment is the end destination for the resulting emissions. Our research range from biochemical mechanisms of toxicity of individual toxicants to the combined effects on populations and communities of chemical cocktails, and includes ocean acidification.

Ecotoxicology is interdisciplinary combining biology, chemistry and toxicology and includes fundamental and applied science. Our research provides strategies and tools for assessing the toxicity of chemicals and consumer products, and for detecting and measuring toxic effects inthe ecosystems.

Ecotoxicology at the Department is a complete research environment coupled to education in environmental science and biology, and to an international Master program in Ecotoxicology. MScs and PhDs in Ecotoxicology have a good potential for employment in industry, consultancyand public authorities.

You can read about the ongoing research here https://www.gu.se/en/biological-environmental-sciences/our-research/environmental-science#Ecotoxicology

Svenska

Idag används fler kemikalier och i större mängd än någonsin tidigare användningen av fossila bränslen ökar. Vattenorganismer är fokus för vår ekotoxikologiska forskning eftersom utsläppentill sist hamnar i den akvatiska miljön. Vår forskning sträcker sig från biokemiska mekanismer för enskilda ämnens toxicitet till effekter på populationer och organismsamhällen av giftiga ämnen i blandningar, och inkluderar effekter av havsförsurning.

Ekotoxikologin är tvärvetenskaplig i gränslandet mellan biologi, kemi och toxikologi och omfattar grundläggande och tillämpad forskning. Forskningen bidrar med strategier och verktygför att bedöma kemikaliers och kemiska produkters giftighet och för att upptäcka och mäta toxiska effekter i ekosystemen.

Ekotoxikologin vid institutionen är en komplett forskningsmiljö kopplad till grundutbildning i miljövetenskap och biologi och till ett internationellt Masterprogram i ekotoxikologi. Magistraroch doktorer i ekotoxikologi har en lovande arbetsmarknad inom industrin, konsultföretag ochvid myndigheter.

Du kan läsa om vår forskning här https://www.gu.se/biologi-miljovetenskap/var-forskning/miljovetenskap#Ekotoxikologi

Aquatic fungal communities in response to global change

Focus on a method development for fungal biomass and diversity estimation

Fungi are an important component for the global biogeochemical cycling in aquatic ecosystems and an important source of food for many consumers, yet they remain little explored. With recent advances in methods, technologies, and data analysis, it is now possible to tackle ecological questions: linking changes in fungal biomass and community diversity to anthropogenic impacts (eg. chemical pollution, increase temperature, hydric stress). Determining fungal biomass in sediment and biofilms has long proven difficult. Ergosterol, a major membrane component, has been used to this end, but fundamental aspects such as the use of total ergosterol (proxy for total fungal biomass) or the free ergosterol contents (proxy for alive fungal biomass) are still not resolved. The nuclear ribosomal infernal transcribed spacer (ITS) region is an universal DNA barcoder marker for Fungi. Nevertheless, the suitability of quantitative Real-Time PCR (qRT-PCR) to estimate biomass of fungi or the choice of genomic DNA (proxy for total fungal assemblages) or RNA (proxy of active fungal assemblages) for both biomass estimations and the structure and diversity of fungal communities is still not resolved. This project wants to advance our knowledge on the best approach for fungal biomass and biodiversity assessments for specific microbial communities, such as fungal sediment and fungal biofilm, to describe ecological changes under global change at a fine scale.

Techniques to be used: fungal cultivation, field sampling, lab experiments, ergosterol analysis using LC-MS/MS, DNA-based analysis using RT-qPCR and DNA/RNA amplicon sequencing.

Supervising team:
Natàlia Corcoll, Dept of Biological and Environmental Sciences, Univ of Gothenburg
Anders Nilsson, Dept of Clinical Neuroscience, Univ of Gothenburg

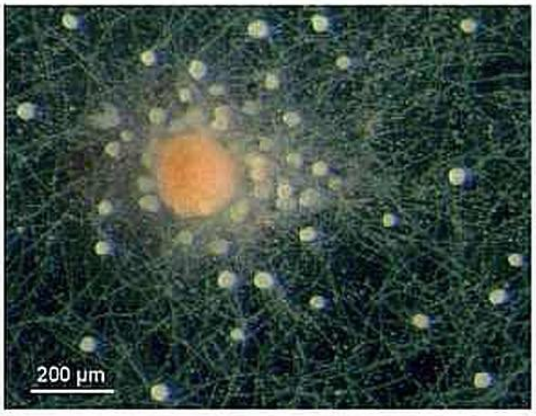
Project suitable for both bachelor and master's thesis projects. Please get in touch with Natàlia Corcoll (natalia.corcoll@gu.se) to explore possible opportunities.

Antibiotics and heavy metals effects on foraminifera

Pollutant effect on propagation of foraminiferal resting stages and foraminifera microbial diet from the sediment propagule bank: comparison of antibiotics and heavy metals

Project description

Foraminiferal resting stages (propagules) and microbial communities are present in the marine sediments worldwide and their discovery (Alve and Goldstein, 2002) has extended the hypothesis that "everything is everywhere but the environment selects" from microbes to protists(e.g. Finlay et al., 1996). Propagules are known to remain viable at least for two years (Alve, 2010) and rest until environmental conditions becomefavorable to initiate growth of different



T. Goldstein

Environmental surveysdemonstrated presence of
ıe highest industrial discharges, but itis unknown how
ɔropagules into adults in presence of different
minifera microbial died, including bacteria and
could affect foraminifera growth. Experimental
raminiferal species grown in the lab under specific

studies targeting changes at the community level are
rare. In this project, sediments taken at the Swedish west
coast will be sieved (to remove all adult

foraminifera and to keep the propagules) and will be exposed to various toxic substances such as metals, biocides and antimicrobials to assess how those affect development time for different species from the propagules into the adults.

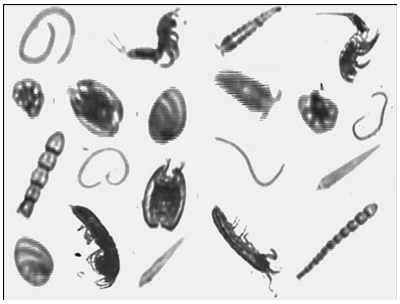
Techniques to be used: Changes in community biomass and diversity will analyzed using microscope analysis, HPLC analysis (algal biomass) and fluorescent DNA stain (bacteria biomass). Depending on the results obtained, environmental DNA (eDNA) metabarcoding toinfer effects on community composition and diversity on microbes could be applied.

Time frame: fall 2022 or spring 2023

Supervisors:

- **Irina Polovodova Asteman,** Dept of Marine Sciences, tel: 0706289944;Email: irina.polovodova@marine.gu.se
- **Natàlia Corcoll,** BioEnv Dept., tel.: 031-7864807.E-mail: natalia.corcoll@gu.se

Coastal marine ecotoxicology



Coastal areas receive a multitude of hazardous substances from different sources, which can affect pelagic and benthic habitats. Our research involves effects of different types of contamination on zoo- and phytoplankton, as well as microbial organisms and meiofauna, and mainly focuses on community level endpoints. Effects can be both on the function and structure of one or several communities. Our approach is experimental, using naturally occurring communities striving to use environmentally relevant conditions and set-up. We currently focus on contamination from shipping, input from local townships, and development of new methods for community ecotoxicological testing, but other topicscan also be of interest.

Our experiments often take place at Kristineberg marine research station, **one of the oldest marine stations for education and research in the world**.

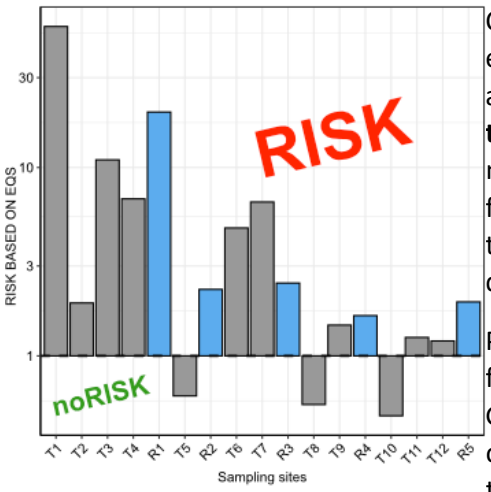
If you are interested in ecotoxicology at the community level, want to investigate a specific type of contamination potentially affecting the marine environment, or method development, please contact Ingela Dahllöf (ingela.dahllof@bioenv.gu.se), Christina Jönander (christina.jonander@bioenv.gu.se), orJenny Egardt (jenny.egardt@bioenv.gu.se).

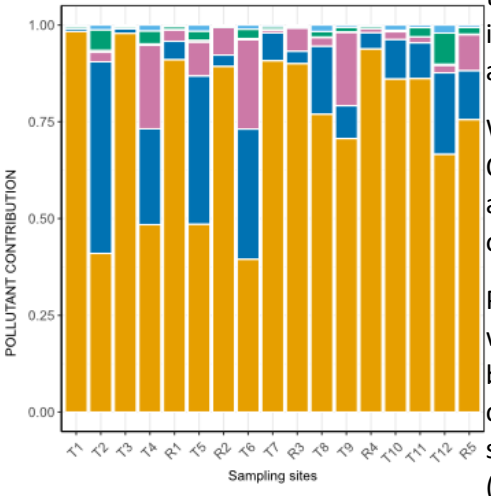
Master, bachelor and applied projects can all be considered.

PREDICT the effect of chemical mixtures on aquatic organisms

ECOTOXICOGENOMICS GROUP, *Environmental chemistry, Environmental genomics, Ecotoxicology*

Project suitable for Master (45 or 60 credits)





Chemicals are continuously discharged into aquatic environments as mixtures (e.g. river, coastal areas, lakes) as aconsequence of human activities. These chemicals may **threatthe ecological status** of aquatic organism, from microbialcommunities to fish, impairing their structures and functions.In PREDICT project you will have the opportunity to estimate *in silico* the impact of mixtures of chemicals on different targetorganisms.

PREDICT will make use of available chemical information frompolluted areas (freshwater and marine) in Sweden, Germany,and Chile. **Pollution fingerprints** will be built and comprehensibly analysed to estimate sites at risk and link them to anthropogenic activities. The project will integrate inorganic and organic pollutants within the mixture assessment when the data is available.

We will compare toxic effect information based on Quantitative structure–activity relationship models (QSAR) and real laboratory testing in order to quantify deviations in our predictions.

PREDICT is a computational-based project and the student willhave the opportunity to improve and/or develop new R-basedtools for an advanced assessment of complex chemicals in theenvironment. Therefore, highly motivated students are welcome to conduct their degree project (Bachelor or Master´s thesis). You will conduct your project in an international and multi-cultural group.

The ECOTOXICOGENOMICS GROUP is part of the FRAM – Centre for Future Chemical Risk Assessment andManagement Strategies at the Department of Biological and Environmental Sciences.
www.gu.se/fram

If you are interested in this project or any potential new idea about chemical pollution dynamics, mixturerisk assessment, DNA-metabarcoding, and or discuss own project ideas, you are welcome to visit/contactme.

Contact person: Pedro Inostroza, pedro.inostroza@gu.se

Understanding biodiversity lost applying Ecotoxicogenomics

ECOTOXICOGENOMICS GROUP, *Environmental chemistry, Environmental genomics, Ecotoxicology*

Project suitable for Master (45 or 60 credits)

Aquatic organisms are exposed to a myriad of chemicals in agricultural areas jeopardising the structure and function of aquatic ecosystems. **Pesticide mixtures** reduce species diversity and the abundance of macroinvertebrates, but do **diversity losses** downscale to **genome and function level**? Is there any link between the pollution fingerprinting and the ecological responses in polluted areas? In this project, you willhave the opportunity to explore these questions both applying prediction modelling and/or field-laboratory work.

Specifically, the project aims to close multiple knowledge gaps regarding whether diversity losses downscale to the genome level affecting gene expression, which compensatorymechanisms are involved in the tolerance to such chemical pressure and if a replacement towards more tolerant invertebrates occurs in agricultural streams.

We will define mixtures in environmental samples and determine -omics responses to those mixtures of chemicals in long-term exposed *Gammarus pulex*, a keystone invertebrate species, in agricultural streams. Special attention will be given to the interaction between the type of adverse biological response of the chemicals (mode of action) and the gene expression in *G. pulex*. A mechanistic understanding will be developed through the exposure to in situ mixtures and artificial mixtures under laboratory conditions.

This project is multi-disciplinary and you will learn approaches from several fields, such as environmental chemistry, environmental genomics, ecotoxicology, prediction modelling. Therefore, highly motivated students are welcome to conduct their degree project (Bachelor or Master´s thesis). You will conduct yourproject in an international and multi-cultural group.

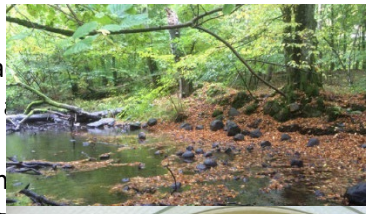
The ECOTOXICOGENOMICS GROUP is part of the FRAM – Centre for Future Chemical Risk Assessment and Management Strategies at the Department of Biological and Environmental Sciences. www.gu.se/fram

If you are interested in this project or any potential new idea about chemical pollution dynamics, mixturerisk assessment, DNA-metabarcoding, and or discuss own project ideas, you are welcome to visit/contactme.

Contact person: Pedro Inostroza, pedro.inostroza@gu.se

Ecology and ecotoxicology of aquatic biofilms for pesticides biodegradation

Project description



Aquatic biofilms are benthic communities of microorganisms (bacteria, cyanoba and protozoa) that control many biochemical cycles in aquatic ecosystems, and very sensitive to toxicants exposure. To date, the role of biofilms to biodegrade substances and reduce their toxicity in freshwater ecosystems is not well known quantify the capacity of river biofilms todegrade pesticides, to identify microorg with higher pesticides biodegradation rates and, to determine enzymes and gene the metabolic pathways of biodegradation. The ultimate goalof this project is to inputs about the potential of aquatic biofilms for pesticides bioremediation in p

- Isolation and characterization of several benthic microbes from river sediments microbiological and biomolecular techniques
- To quantify the capacity of aquatic biofilms to degrade pesticides when:
- exposed to single compounds or mixtures of pesticides
- microorganisms growing alone or in microbial consortium
- under different temperature and organic matter concentrations
- To assess toxic effects of selected pesticide compounds on microbes (microalgae,bacteria and fungi) when exposed alone or in combination

- To identify microorganisms associated with higher pesticides biodegradation rates,enzymes and genes that participate in the metabolic pathways of biodegradation

Methods

Approaches included in this project are: field sampling, microcosms experiments or microbialdose-response toxicity assays. Techniques to be applied, include: isotope and radiolabeled compounds, flow cytometer, chlorophyll fluorescence techniques, microbial DNA/RNA extraction, gene amplification (PCR/qPCR), sequencing, bioinformatics, enzymatic activities.

Application

Within this project it possible to find sub-projects for students interested in do an Appliedproject, Bachelor Degree project or Master Degree project. Interested?

Contact person: Associate Professor Natàlia Corcoll (natalia.corcoll@gu.se) to discusspossibilities and mutual interests.

Nano-Ecotoxicology

Projects suitable for Master, 45 or 60 credits

Are nanoparticles harmful to aquatic organisms?General background

Nanomaterials (nanoparticles) are 1-100 nm large materials (particles) which have extraordinary physicochemical properties. Nanomaterials can be found in a variety of productswe use every day. They are, for example, used as antibacterial agents in children's toys and textiles, as functional ingredients (e.g., as colorant) in food, as UV-filters in cosmetics and sunscreens, as biocides in anti-fouling paints (e.g., for boats and house facades), and as pesticidesin agriculture. Many of these nanomaterials enter the sewage system (e.g., they are released during cloth washing, are washed off the body during showering, or are egested with the urine/feces). However, often they cannot be removed by current wastewater treatment technologies and therefore are eventually discharged into the aquatic environment together with the treated wastewater. Furthermore, many **nanomaterials are** directly **released into streams, lakes and the ocean** (e.g., due to sunscreens being washed off the body duringswimming, due to weathering /disintegration of anti-fouling paints, or due to agricultural runoff).The production, use and release of nanomaterials into the environment it expected to continue to increase. Therefore, **exposure of aquatic organisms to nanomaterials is inevitable**. This givesrise to **concern**, as many nanomaterials (nanoparticles) are probably **able to surpass biological barriers** (e.g., gill and gastrointestinal epithelia, blood brain barrier). Furthermore, nanomaterialshave a high surface reactivity, which increases the **risk of harmful interactions with biological macromolecules** (e.g., proteins, enzymes, lipids). Moreover, many nanomaterials have a high adsorptive capacity, that is, they **may adsorb and carry other pollutants into the organism (Trojan horse-effect)**. However, Today, **we still have very limited knowledge on toxicodynamicsand toxicokinetics of nanomaterials in aquatic organisms**.

Our research

With our research, **we aim at filling important gaps of knowledge** related with

- **Molecular and cellular mechanisms of nanoparticle toxicity**
- **Bioaccumulation of nanoparticles**
- **Fate and effect of nanoparticles in aquatic food webs (trophic transfer)**
- **Mixture toxicity effects of nanoparticles and organic chemical pollutants**

The increased understanding of how specific properties of nanomaterials are linked to their toxicity **will help us to better manage the environmental risk associated with nanomaterials** currently used in products and **develop nanomaterials which are safe-by-design**.

Your project

At present, we have **several large research projects addressing highly topical research questionsin nano-ecotoxicology** and **we look forward to welcome interested and highly motivated students** to carry out their degree project (Bachelor or Master's thesis) within this **novel and exciting field**.

Degree projects in our group typically address a **well-defined research question** (usually a small scientific problem) related with one of the ongoing research projects. The project/study is planned together by the supervisor and the student, offering you the **possibility to include** your**own research interests and learning goals** (e.g., interest in a specific method). In general**, projects** are **well structured** and comprise a series of experiments, which –depending on the results obtained– may give rise to a **conference contribution** and or **scientific publication**. You will receive **training** in the **scientific method** and a variety of **important laboratory techniques** before and during your project. The spectrum of techniques varies dependent on the research question addressed. Typically, it encompasses **nanomaterial characterization** techniques (dynamic light scattering, transmission electron microscopy), **cell culture-techniques** and or working with live **fish** (or aquatic invertebrates), different **molecular biology and biochemical techniques** (cell/tissue homogenization, preparation of subcellular fractions, RNA isolation and quantification, cDNA synthesis, qPCR, enzyme activity assays, toxicity assays), as well as measurement of **physiological and behavioral endpoints.** In addition, while carrying out your degree project in our group, you will gain an insight into how it is to work in an **international, multi-cultural research environment.**

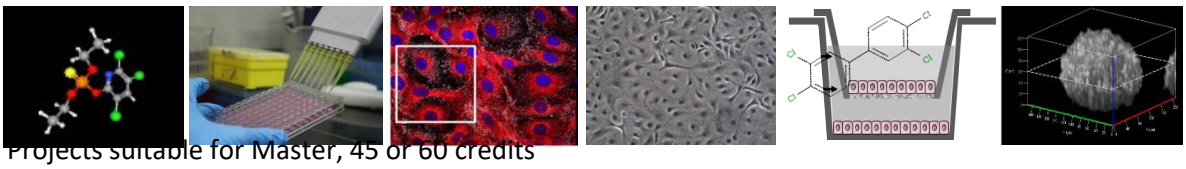
If you are **interested in carrying out a degree project** in nano-ecotoxicology, would like to have **more detailed information** on potential projects, and or discuss **own project ideas**, you are very **welcome to stop by** and or **contact me/us *via* email**.

Visiting Address:

Medicinaregatan 18A (Zoology building), Floor: 3; Room number: 556

Contact person: tobias.lammel@bioenv.gu.se

Fish cell-based in vitro methods



Projects suitable for Master, 45 or 60 credits

Can we use alternative methods to predict the toxicity of chemical substances and thus avoid animal testing?

General background

Chemical substances placed on the European market **need to be assessed if they are hazardousto** the environment including **aquatic organisms**. Most regulatory frameworks (e.g., REACH) demand that chemicals with a specific set of properties and annual production above a given threshold level are tested for their acute toxicity, bioaccumulative potential and long-term toxicity in **fish**. **Acute toxicity**, **bioaccumulation** and **long-term toxicity** is typically tested on **liveanimals** (*in vivo*-studies). *In vivo* studies, however, are not only expensive but also, and above allraise **strong ethical concerns**

due to **suffering and killing of animals**.

During recent years enormous efforts have been undertaken to develop **alternative test methods** which **can help to reduce the amount of animals** used in chemical toxicity testing (**3*R*'s = *Reduction, Refinement, Replacement of animal tests***). However, most efforts have concentrated on developing methods to predict chemical toxicity in humans. **Alternative methods that can predict the toxicity of environmental pollutants in aquatic vertebrates are still scarce**.

Our research

In our laboratory, **we aim at developing alternative test methods based on continuous fish cell lines,** which can help to **reduce the number of fish** that nowadays is used in regulatory **chemical toxicity testing**.

For instance, in the ***sph3roiD project*** we aim at developing an **organotypic *in vitro* model from afish liver cell line** which can be used to assess and predict **hepatic clearance, bioaccumulation** and **chronic liver toxicity testing** of **chemical substances** in **fish** (including manufactured nanomaterials).

For this purpose, we grow (culture) fish liver cells in form of **three-dimensional (3D), spherical micro-tissues** (so called ***spheroids*** or ***organoids***) which assists in restoring **liver-specific properties** (e.g., high expression levels of detoxification enzymes) and **better mimics the originaltissue/organ environment**.

Your project

Each semester (spring and autumn) we offer one highly motivated student to work with us in the *sph3roiD project* (see above). The student will be **directly involved in the ongoing research activities**, i.e., work at the forefront of research in this **exciting emerging area**. The project will address a **well-defined research question** (i.e., a small scientific problem), which can be successfully addressed within the time you have available of your thesis. In general, we aim thatstudents get the possibility to convert their results into a **conference contribution** and or **scientific research article**, which may give them an advantage during potential later PhD applications. As a Bachelor or Master student in our group, you will receive **training** in the **scientific method** and a variety of **important laboratory techniques.** The spectrum of techniquesvaries dependent on the specific research question addressed, but typically includes different **cell culture-techniques** (freezing/thawing of cells, maintenance and sub-culturing of cells, seeding of cells, cell homogenization, preparation of sub-cellular factions, etc.), **molecular biology techniques** (RNA isolation and quantification, cDNA synthesis, qPCR), **biochemical techniques** (protein determination, enzyme activity assays, cytotoxicity assays), and microscopytechniques (e.g., sample preparation for light, fluorescence and or electron microscopy, image analysis). In addition, carrying out your degree project in our group, you will gain experience in working in an **international, multi-cultural environment.**

Contact

If you are **interested in carrying out a project** at the interface of **environmental science, cellular toxicology, and tissue engineering,** and would like to have **more specific information** on current projects you are very **welcome to stop by** or **drop me an email**. **Contact person:**
tobias.lammel@bioenv.gu.se

Visiting Address:
Medicinaregatan 18A (Zoology building), Floor: 3; Room number: 556

Effects of (micro) plastics and associated chemicals on fish

Plastics are a complex groups of materials that can contain thousands of different chemicals, including those added to products, or environmental contaminants that bind to plastics in marine and aquatic systems. Their presences in the environment, either as large objects or as microplastics, is ubiquitous, and hundreds of different species have been described with plasticparticles in their guts. While data describing the impacts of plastics on different organisms in the environment are accumulating, the effects of these exposures, and the most important variables driving impact, are still not well known and many unanswered questions remain.

Research in our group is focused on gaining an improved understanding of the effects of microplastics and associated chemicals on fish. To do this, we work with different kinds of materials and particles (e.g. textiles fibers, commercial pellets, microplastics from consumer goods, artificial turf, etc.) and chemical contaminants (plastic additives, endocrine disruptors, metals, pesticides, etc). We address different means of exposure (via water, food, sediment, trophic transfer) and measure effects on levels from regulation of gene expression to physiological parameters to behavioral changes. In addition, we can advise students conductingliterature-based studies, e.g. risk assessments of specific chemicals or particles.

Contact persons: Bethanie Carney Almroth Bethanie.carney@bioenv.gu.se

Agathe Bour agathe.bour@bioenv.gu.se

4. Biology - focusing on biodiversity with Gothenburg Global Biodiversity Centre

Gothenburg Global Biodiversity Centre

We aim to understand how biological diversity has evolved and how it will be affected by on-going climate change and habitat destruction. The scope of our studies ranges from specific taxonomic groups in particular geographic regions to global cross-taxonomic patterns.

We integrate data and methodologies from genomics, molecular phylogenetics, palaeobiology, biogeography, climatic modelling, bioinformatics and ecology. Our work has shed further light on the evolution of species and biomes, but a lot more remains to be done.

Factors effecting local abundance of mammalian species

Behavioural ecology, large mammal ecology

Camera traps have been used along high traffic 'elephant highways' in a national park of Botswana. During data extraction, group size and age category of the wildlife captured were recorded. The student will investigate changes in local relative abundance of various species (using capture rate and group size) in relation to factors such as season and river level.

For this Masters project, we seek a motivated, independent student with an interest in behavioural ecology. Familiarity with spatial analyses and the program R as well as experience of network analysis is desired but not required. Someone with an artistic background/interest would also be of interest.

Contact: Kate Evans, kate@elephantsforafrica.org ; Søren Faurby, soren.faurby@bioenv.gu.se;

The demography of African Savannah elephants - remote and in person observations

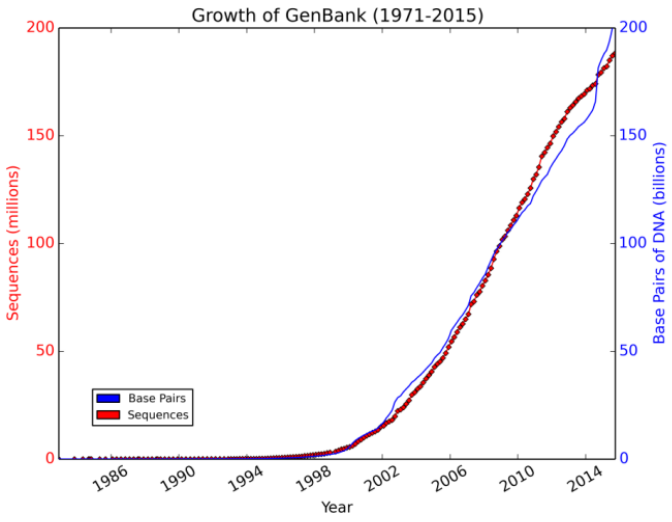
Behavioural ecology, large mammal ecology

Camera traps have been used along high traffic 'elephant highways' in a national park of Botswana. During data extraction, group size and age category of the elephants captured were recorded. In additional demographic data was collected during research drives. Using these data the student will investigate if the group sizes and demographics of elephants using the highways during the daytime differ to those observed with research session data.

For this Masters project, we seek a motivated, independent student with an interest in behavioural ecology. Familiarity with spatial analyses and the program R as well as experience with experience of processing camera trap data is desired but not required.
Contact: Kate Evans, kate@elephantsforafrica.org ; Søren Faurby, soren.faurby@bioenv.gu.se;

Patterns in the accumulation of genetic data

Diversity, evolution, spatial patterns



Very few organism groups have genetic data for all or even for a large fraction of the species and analyses of diversity patterns therefore have to make assumptions about the placement of the missing species. For computational convenience and due to lack of knowledge it is generally assumed that they are placed randomly in the phylogeny even though there are good reasons to expect this to be wrong. In this project we wish to analyze the pattern of accumulation of genetic data among species to better understand what determines what species have and does not have genetic data in order to enable researchers to better

include the missing species into evolutionary or ecological analyses.

For this master project familiarity with spatial analyses, with the program R and with basic bioinformatics or phylogenetics is desired but not required.
Contact: Søren Faurby, soren.faurby@bioenv.gu.se

Mismatch between pollinators and plants

Extinction, islands, birds, pollination, plant-animal interactions

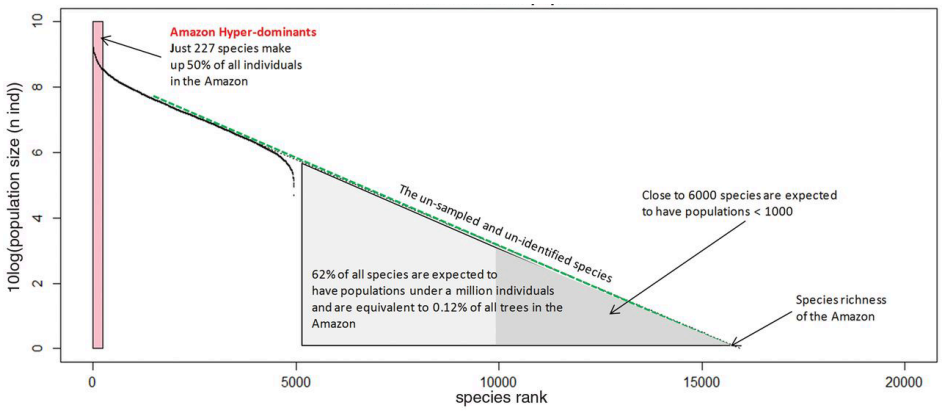
Oceanic islands have seen very large extinction rates, with as much as 90% of all extinct birds being island dwellers. As a function of this, many other species may potentially suffer in the future, as in the case of red flowered plants, which generally are exclusively bird pollinated. The goal of this project is to identify the fraction of plant species on various oceanic islands that are likely to be bird pollinated and investigate if there is consistent patterns in whether bird pollinated plants on islands are more likely to be endangered than other plants. The project will expand on an earlier master thesis focussed on New Zealand but expand the analyses to additional islands.

For this master project familiarity with spatial analyses and with the program R is desired but not required.
Contact: Søren Faurby, soren.faurby@bioenv.gu.se

The relationship between abundance and range size

Plants, spatial analysis, macroecology

Some species are more abundant than others. If tree stems are counted across the immmense area of Amazonia, we find that only a few species acutally make up the bulk of individuals and most species are rare (figure above).



Combining data on the spatial distribution of abundant and rare species and their abundances, we can test for correlation. These results could also be complimented with available data on genetic diversity.

In this master project in plant evolution, familiarity with spatial analyses and with the statistical platform R is desired but not required. Contact: Christine Bacon, christine.bacon@bioenv.gu.se

Species delimitation and demographic history of açaí palm trees

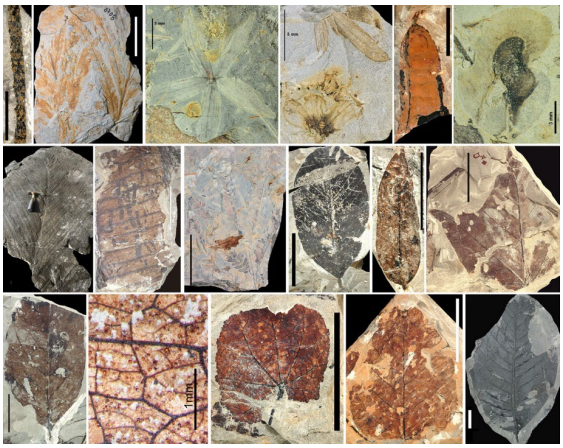
Plant systematics, population genetics, diversification

Euterpe is popularly known in Brazil as açaí and two out of the seven known *Euterpe* species (*E. precatoria* and *E. oleracea*) represent the 1st and 6th most abundant and widespread plants in Amazonia, with mean estimated population sizes of 5.2 and 3.8 billion individuals, respectively. The other five species are either rare (*E. longibracteata*) and habitat-specialized (*E. catinga*), or have dispersed into different biogeographic regions (*E. edulis, E. luminosa, E. broadwayi*). Here, we aim to review *Euterpe* through an increased sampling effort and the use of species delimitation methods based on coalescent theory to unveil new species, resolve species complexes, and infer the full evolutionary history of *Euterpe*. The resolution of such complexes will refine predictions about Amazonian species diversity and identify previously unknown and potentially threatened taxa and key habitats as new conservation priorities.

We seek independent students interested in learning laboratory skills in genomics.
Contact: Christine Bacon, christine.bacon@bioenv.gu.se

Developing models for rainforest evolution

Evolution, tropical forest, diversity patterns



Palms have been recorded in the fossil history of tropical rainforests since they first emerged (see Wing et al. 2009, depicted below). Along with other mega-thermal angiosperms, those that are frost-intolerant and have physiological requirements that largely constrain them to tropical environments, they have been proposed as models for rainforest evolution. In this project we explicitly test the idea of palms being models for tropical rainforest presence or absence at a global-scale. Using data from transects, we test whether their distribution matches current tropical biomes at various geographical scales.

For this master project in evolution, familiarity with spatial analyses and with the statistical platform R is desired but not required.
Contact: Christine Bacon, christine.bacon@bioenv.gu.se

Camera traps have been used along high traffic 'elephant highways' in a national park of Botswana. During data extraction, group size and age category of the wildlife captured were recorded. The student will investigate changes in local relative abundance of various species (using capture rate and group size) in relation to factors such as season and river level.

Plant response to changing cli

Plant evolution, Arctic, adaptation

The Arctic is changing climate conditi anywhere else on earth. In efforts to change, we can use museum and citiz track shifts in geographic distribution fruiting times, and plant size through time. We are also using phylogenomic tools to understand patterns of plant adaptation to changing temperature and day length.

For this Masters project, we seek a motivated, indepe behavioural ecology. Familiarity with spatial analyses of network analysis is desired but not required. Some would also be of interest.

For this master project in plant evolution, familiarity with spatial analyses and with the program R is desired but not required. If you are interested in this or any potential new idea about plant evolution, Arctic diversity, and genomics, or want to discuss your own project ideas, you are welcome to contact Christine Bacon, christine.bacon@bioenv.gu.se

Contact: Kate Evans, kate@elephantsforafrica.org ; S

5. Biology - Plant Ecology, Physiology and Environmental Sciences (PEPES)

PEPES is a research area studying the interactions between vegetation and the atmosphere. Our research focus is at the interface between terrestrial eco(physio)logy and atmospheric science, with particular interest in how climate change and air pollution affect plants and ecosystems ranging from arctic to tropical. You can read more about our research here: https://www.gu.se/en/biological-environmental-sciences/our-research/plant-ecology-physiology-environmental-science

We regularly supervise BSc and MSc thesis projects in our various fields of research, i.e. ecophysiology, ecology, ecosystem science and environmental science. Some possible project areas are listed below, but mostly specific projects are formed in discussions between the student and potential supervisor. You can get an idea of what kind of projects that we supervise by looking at the descriptions of the research interests of individual PEPES members (click on the links to researchers at the webpage).

Below are listed some areas within which PEPES members have research and may supervisethesis projects:

Ecophysiology and ecosystem processes in tropical forests.

Ecophysiological and ecological research on the climate sensitivity of trees in montane rainforest and forest plantations in Rwanda. This is part of a long-term collaboration between the University of Gothenburg and the University of Rwanda. Swedish students may applyfor stipend from the Swedish International Development Cooperation Agency (Sida) to cover costs associated with field work in Rwanda. **Contacts**: Johan Uddling and Göran Wallin, johan.uddling@bioenv.gu.se and

goran.wallin@bioenv.gu.se

Airborne pollen and the ecology of plants that produce them.

Research on this includes the effect of climate on phenology and reproductive effort as well as meteorology, pollen release and transport. The impacts of allergenic pollen on symptoms and life quality are also studied in cooperation with allergists, includingthe additive effects of allergenic pollen and air pollution. **Contact**: Åslög Dahl, aslog.dahl@bioenv.gu.se

System ecology from a Biogeophysical perspective.

Research questions with focus on how human land use and management and environmental change affect the fluxes of carbon, nitrogen, phosphorous and radionuclides in terrestrial ecosystems. Process-oriented models are used to analyze relationships between management, vegetation, soil, climate and hydrology. Data from long-term experiments and the Swedish national soil inventory are used to test hypotheses and validate models. **Contact**: Annemieke Gärdenäs, annemieke.gardenas@bioenv.gu.se

Air pollution effects on vegetation.

Research on air pollutants, including their effect on vegetation and the dynamics of their occurrence in ecosystems. Particular focus on the effects of ground-level ozone on crops and trees. Most of this research includes international collaboration with groups in the UK, China, India and Australia. **Contact**: Håkan Pleijel, hakan.pleijel@bioenv.gu.se

Urban vegetation.

Research on the effects of urban vegetation on ecosystem services such as cleaning of the air (by air pollution deposition to vegetation), noise reduction, and creation of favorable microclimatic conditions. Moreover, the vitalityof urban trees and how it is affected by the harsh urban environment and human planting methods are also studied in collaboration with researchers at the Earth Science department. **Contacts**: Håkan Pleijel, Lasse Tarvainen and Johan Uddling, hakan.pleijel@bioenv.gu.se, Lasse.Tarvainen@bioenv.gu.se and johan.uddling@bioenv.gu.se

Tree temperature acclimation.

Investigation of tree acclimation capacity to increased temperature using controlled experiments and studies along natural temperature gradients. Different types of thesis projects are possible on this topic.**Contacts**: Johan Uddling and Göran Wallin, johan.uddling@bioenv.gu.se and goran.wallin@bioenv.gu.se

Please contact us to discuss possible thesis projects!

Choosing urban trees for stress tolerance and provision of ecosystem services

This topic includes ecophysiological studies aimed at understanding which tree traits determine the severity of environmental stress (flooding, drought and heat) experienced by different tree species in the urban setting. In addition, the topic can include survey-based studies regarding the general public's views of urban trees, the ecosystem services that they provide and species selection for

public spaces. This research is part of the project “Sustainable trees to promote sustainable cities in a changing climate” with the overall aim to generate guidelines describing which species are suitable for planting in various urban settings based on which ecosystem services they provide, their stress tolerance and their perceived desirability by the general public. The studies are carried out in collaboration with the Gothenburg Botanical Garden and the Swedish University of Agricultural Sciences.

Contact: lasse.tarvainen@bioenv.gu.se

How will Arctic and alpine plants respond to climate change?

What are the consequences of vegetation change for the functioning of Arcticecosystems?

The Arctic and alpine areas of the world are warming much faster than the global average.We aim to understand how tundra plants will respond to this rapid change, and what the consequences of this are for the services and functions that tundra ecosystems provide.

Project description:

We (the EDGE lab, edge-ecology.com) conduct research on many topics related to tundra vegetation change, including (1) understanding the **relationships between temperature andplant traits** (e.g. canopy height, leaf nutrient content, the timing of leaf green-up and flowering) across scales, from an individual plant to the entire tundra biome, (2) exploring the potential for **phenological and functional traits to predict a species’ response to temperature change**, (3) linking vegetation change to changes in **ecosystem functions** such as carbon and nutrient cycling, (4) exploring the biotic and abiotic **limits to species’ range shifts** in the face of climate warming, and (5) investigating the **consequences of tundra vegetation change for pollinators**.

We are especially looking for students who are interested in conducting **field work** in the Arctic (e.g. Latnjajaure, Greenland or Svalbard), but several projects are available for students interested primarily/only in **data analysis**. There is also a possibility to work on **“bigdata” synthesis** using a tundra-wide database of community composition change and functional traits (e.g. https://tundratraitteam.github.io).

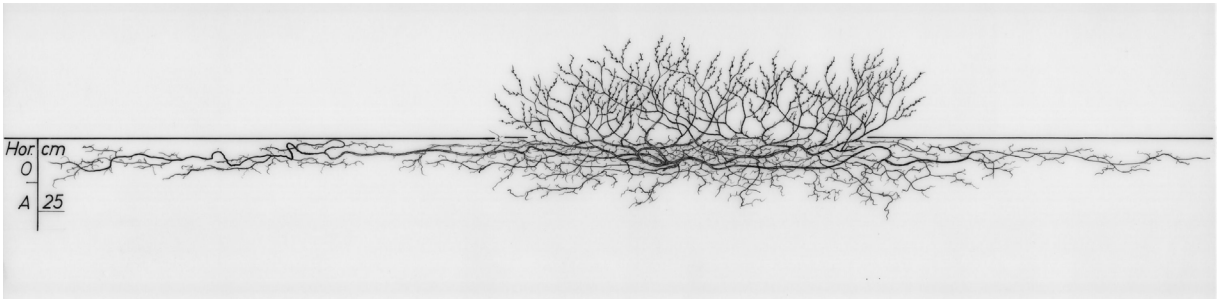
Sounds interesting? Please send an email to Anne Bjorkman (anne.bjorkman@gu.se).

Ecology of Arctic vascular plants, bryophytes, and lichens

Ecosystems that store unusually large amounts of soil carbon (Boreal peatlands and forests, Arctic tundra) are often characterised by a high abundance of bryophytes and lichens. Yet, only few ecological studies focus on these important taxa. Our group has collected data on the co-occurrence and abundance of vascular plants, bryophytes and lichens on environmental gradients around Latnjajávri (northern Sweden). These data could be used to determine **how bryophytes and lichens respond to changes in the environment, including climate warming and increased abundance of vascular plants**.

We also have samples of the most common bryophyte species from the area that could be measured and used to develop a project on the topic of functional ecology of mosses. One could ask, for example, **are there any unifying characteristics in those bryophyte species that are most threatened by climate change?**

Role of plant roots in Arctic ecosystems



Plant roots constitute the majority of plant biomass in the tundra, but there are major knowledge gaps in how they help plants adapt to environmental conditions, and how they affect ecosystem functioning. In the mountain tundra of Gibbesjávri we have measured microclimate, soil characteristics, vascular plant community composition and biomass of leaves, stems and roots, along with carbon fluxes. Above-ground functional traits are also available for all species. With some work, the dataset could be expanded to include information on below-ground functional traits and total leaf area. One potential project could investigate **how environmental variables like temperature and soil moisture affect total carbon stored in the ecosystem, how much of this is stored in roots, and**

whatkinds of roots are most adaptive in future climatic conditions.

Interested? Please contact Anne Bjorkman (anne.bjorkman@bioenv.gu.se)

Soil microbial responses to changing climate and nitrogen availability

Suitable for a master of science project in Environmental Sciences (earliest Autumn 2023)

Background

During last decade nitrogen (N) deposition over Europe declines, whilst air temperature is increasing. Soil microbial functional groups are important decomposers and they are sensitive to both temperature and N availability. Their responses may lead to changes in soil C storage. The soil transplant experiment was carried out between 2013-2017 in collaboration with the University of South Bohemia, Czech Republic and Swedish Univ. of Agricultural Sciences. After recollecting the soil transplants, the following soil microbial variables were measured C biomass, N biomass, enzymatic activities, and Phospholipid Fatty Acids (PLFA), including metabolic stress defined as the ratio between cyclopropyl and precursor PLFA 2017. We have done a preliminary statistical analysis of the recollected soil cores and found some indicationsof microbes' sensitivity to N availability.

The task of the student is to carry out a more complete statistically analysis, this could include Multiple regression, PCA or CCA analysis.

The aim of this MSc-thesis project is to assess by means of statistically analyses the responses of soil microbial functional groups and enzyme activity to

i) change in climate,
ii) change in N availability and
iii) the combined change of both climate and N availability.

Methods

Literature review
Data compilation and statistical analysis; Multiple regression, PCA, and CCA.Writing report and presentation

Required knowledge: Environmental Science, Statistics, Biology, and English.

Description of dataset:

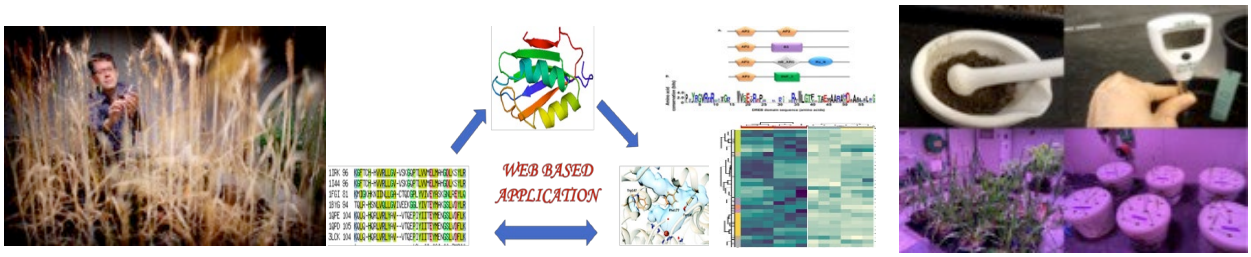
The soil transplant experiment was carried out in three Norway spruce field sites; Stråsan (central Sweden), Skogaby (SW-Sweden), and Čertovo (south Czech Republic) on Podzolic soils.The mean annual temperature is 3, 8 and 5 °C and the current N deposition is 3, 15 and 15 kg N/ha.year in Stråsan, Skogaby and Čertovo respectively. In addition, there were N fertilization treatments at both Swedish sites. Intact soil cores were sampled (length 35 cm) and installed insoil at their host site 2013; in coarse mesh bags so that fine roots and fungi's mycelia could grow in. Cores were exchanged between each site and treatment (n =4) plus two internal controls and recollected 2017.

Interested? Please contact Annemieke Gärdenäs, annemieke.gardenas@bioenv.gu.se

Contribute to Future food security - and become co-author on a paper!

Are you interested in being part of the future of food security? Are you an environmental science student with passion for research? Then we hope to hear from you! We are happy to welcome you to join us in our plant breeding lab! There are six projects under this umbrella:

Comparative Genomics of the newly sequenced wheat cultivars



Are you interested in being part of the future of food security? Then we hope to hear from you! We are happy to welcome you to join us in our plant breeding lab!

Background
We work with wheat-OMICs related to salt, drought and nitrogen usage efficiency (NUE). With the recent revised release of the wheat genome in 2022, we identified several TF families using this newly released wheat genome (IWGSC). Recently, 15 new wheat cultivar genomes were sequenced. Thus, we intend to perform Comparative Genomics of the newly sequenced 15 wheat cultivars with Chinese spring. And finally develop a web app for accessing this information. The data related to this study will be downloaded from public databases. We have earlier published papers about the TF family WRKY (Hassan et al 2019) and DREB (Hassan et al 2021) where we identified TF genes with the help of students performing applied projects, also becoming co-authors on the papers.

If you have a background in **plant biology and/or cell and molecular biology with competence also in computers/bioinformatics** you are very welcome to apply for the project.

Student project
We will use python, flask and various bioinformatics tools related to sequence analysis that includes domain identification, protein structure prediction, DNA binding site analysis, identification of functional genes to better understand the role of genes in stress tolerance that will improve food security.

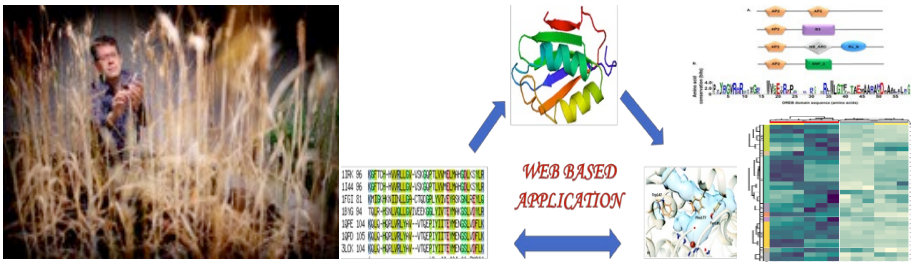
Location
The work will take place at the Department of Biology and Environmental Sciences.

Duration Applied 15 hp projects, for master 60 hp/bachelor 30 hp.

Tasks
You will be introduced into omics and can perform pipeline work following a flowchart. If you have experience in omics you can also be part of building our omics platform i.e. use of coding. We will work in close connection with a bioinformaticist from the plant biotech company, OlsAro Crop Biotech AB.

Application
Please apply by sending your CV, references, and a short letter describing your background to Professor Henrik Aronsson (Henrik.aronsson@bioenv.gu.se)

Genome-wide analysis of transcription factor gene families



Are you interested in being part of the future of food security? Then we hope to hear from you! We are happy to welcome you to join us in our plant breeding lab!

Background
We work with wheat-OMICs related to salt. With the recent revised release of the wheat genome in 2022, we identified several TF families using this newly released wheat genome (IWGSC). Thus, we intend to perform **Genome-wide Analysis of Different TF Family** involved in salt stress. The data related to this study will be downloaded from public databases. We have earlier published papers about the TF family WRKY (Hassan et al 2019) and DREB (Hassan et al 2021) where we identified TF genes with the help of students, also becoming co-authors on the papers.

If you have a background in **plant biology and/or cell and molecular biology with competence also in computers/bioinformatics** you are very welcome to apply for the project.

Student project
We will use various bioinformatics tools related to sequence analysis that includes domain identification, protein structure prediction, DNA binding site analysis, identification of functional genes to better understand the role of genes in stress tolerance that will improve food security.

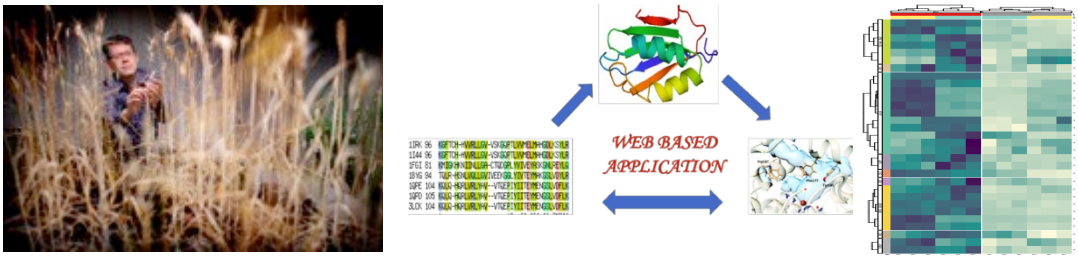
Location
The work will take place at the Department of Biology and Environmental Sciences.

Duration
Applied 15 hp projects, for master 60 hp/bachelor 30 hp.

Tasks
You will be introduced into omics and can perform pipeline work following a flowchart. If you have experience in omics you can also be part of building our omics platform i.e. use of coding. We will work in close connection with a bioinformaticist from the plant biotech company, OlsAro Crop Biotech AB.

Application
Please apply by sending your CV, references, and a short letter describing your background to Professor Henrik Aronsson (Henrik.aronsson@bioenv.gu.se)

Analysis of bulk RNA sequencing data to fight salinity



Are you interested in being part of the future of food security? Then we hope to hear from you! We are happy to welcome you to join us in our plant breeding lab!

Background
We work with wheat-OMICs related to salt. With the recent revised release of the wheat genome in 2022, we identified several TF families using this newly released wheat genome (IWGSC). Thus, we intend to perform differential expression analysis of all wheat genes and look specifically for the different TF genes that are expressed/co-expressed in wheat genome under salt stress. The data related to this study will be downloaded from public databases. We have earlier published papers about the TF family WRKY (Hassan et al 2019) and DREB (Hassan et al 2021) where we identified TF genes with the help of students performing applied projects, also becoming co-authors on the papers,

If you have a background in **plant biology and/or cell and molecular biology with competence also in computers/bioinformatics** you are very welcome to apply for the project.

Student project
We will use bioinformatics tools related to bulk RNA sequence analysis that includes genome mapping, feature count analysis and packages related to differential gene expression analysis to better understand the role of genes in stress tolerance that will improve food security.

Location
The work will take place at the Department of Biology and Environmental Sciences.

Duration
Applied 15 hp projects, for master 60 hp/bachelor 30 hp

Tasks
You will be introduced into omics and can perform pipeline work following a flowchart. If you have experience in omics you can also be part of building our omics platform i.e. use of coding. We will work in close connection with a bioinformaticist from the plant biotech company, OlsAro Crop Biotech AB.

Application
Please apply by sending your CV, references, and a short letter describing your background to Professor Henrik Aronsson (Henrik.aronsson@bioenv.gu.se)

Screen for improved nitrogen use efficiency in wheat

Are you interested in being part of the future of agriculture? Then we hope to hear from you! We are happy to welcome you to join us in our plant breeding lab!

Background
To address the challenges of climate change and food security globally a mutagenized wheat population have been developed. The population have for instance been used for screening for salt tolerant wheat lines. Addressing the challenge of 9% of the world's land and 20-50% of the irrigated land in the world being salt contaminated. These projects involve working with the same mutagenized wheat population with the aim of finding also other traits that could highly impact global agriculture, in this case more efficient uptake of nitrogen by wheat. We work in close relation with a plant biotech company, OlsAro Crop Biotech AB.

If you have a background in **plant biology, cell and molecular biology and environmental biology** or closely related fields you are very welcome to apply for the project.

Student project
Developing assays and screen population for wheat lines with high efficiency in utilizing available nitrogen in soil also known as Nitrogen Use Efficiency (NUE).

Location
The work will take place at the Department of Biology and Environmental Sciences next to the Botanical garden.

Duration
Applied 15 hp projects, for master 60 hp/bachelor 30 hp.

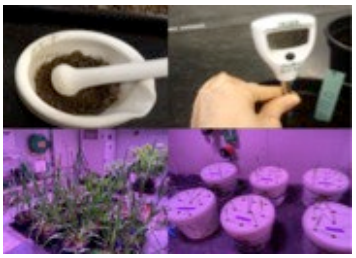
Tasks
You will be part of developing the last details in the stress method (soil/climatic conditions) and performing cultivation of wheat lines in the specific conditions. You will select the best lines and analyze and characterize genes (via qPCR) coupled to the specific trait using bioinformatics tools. You will also analyze the stress method to optimize the growth system.

Application
Please apply by sending your CV, references, and a short letter describing your background to Professor Henrik Aronsson (Henrik.aronsson@bioenv.gu.se)

Screen for improved drought tolerance in wheat

Are you interested in being part of the future of agriculture? Then we hope to hear from you! We are happy to welcome you to join us in our plant breeding lab!

Background



To address the challenges of climate change and food security globally a mutagenized wheat population have been developed. The population have for instance been used for screening for salt tolerant wheat lines. Addressing the challenge of 9% of the world's land and 20-50% of the irrigated land in the world being salt contaminated. These projects involve working with the same mutagenized wheat population with the aim of finding also other traits that could highly impact global agriculture, in this case improved drought tolerance by wheat. We work in close relation with a plant biotech company, OlsAro Crop Biotech AB.

If you have a background in **plant biology, cell and molecular biology and environmental biology** or closely related fields you are very welcome to apply for the project.

Student project
Developing assays and screen population for wheat lines with drought tolerance.

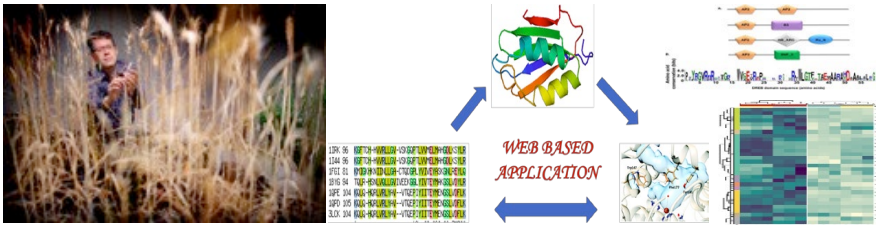
Location
The work will take place at the Department of Biology and Environmental Sciences next to the Botanical garden.

Duration
Applied 15 hp projects, for master 60 hp/bachelor 30 hp.

Tasks
You will be part of developing the last details in the stress method (soil/climatic conditions) and performing cultivation of wheat lines in the specific conditions. You will select the best lines and analyze and characterize genes (via qPCR) coupled to the specific trait using bioinformatics tools. You will also analyze the stress method to optimize the growth system.

Application
Please apply by sending your CV, references, and a short letter describing your background to Professor Henrik Aronsson (Henrik.aronsson@bioenv.gu.se

Genome-wide analysis of Nitrogen Use Efficiency for a better environment



Are you interested in being part of the future of food security? Then we hope to hear from you! We are happy to welcome you to join us in our plant breeding lab!

Background
We work with wheat-OMICs related to nitrogen usage efficiency (NUE). With the recent revised release of the wheat genome in 2022, we identified several TF families using this newly released wheat genome (IWGSC). Thus, we intend to perform **Genome-wide Analysis of Different TF Family** involved in NUE. The data related to this study will be downloaded from public databases. We have earlier published papers about the TF family WRKY (Hassan et al 2019) and DREB (Hassan et al 2021) where we identified TF genes with the help of students, becoming co-authors.

If you have a background in **plant biology and/or cell and molecular biology with competence also in computers/bioinformatics** you are very welcome to apply for the project.

Student project
We will use various bioinformatics tools related to sequence analysis that includes domain identification, protein structure prediction, DNA binding site analysis, identification of functional genes to better understand the role of genes in stress tolerance that will improve food security.

Location
The work will take place at the Department of Biology and Environmental Sciences.

Duration
Applied 15 hp projects, for master 60 hp/bachelor 30 hp.

Tasks
You will be introduced into omics and can perform pipeline work following a flowchart. If you have experience in omics you can also be part of building our omics platform i.e. use of coding. We will work in close connection with a bioinformaticist from the plant biotech company, OlsAro Crop Biotech AB.

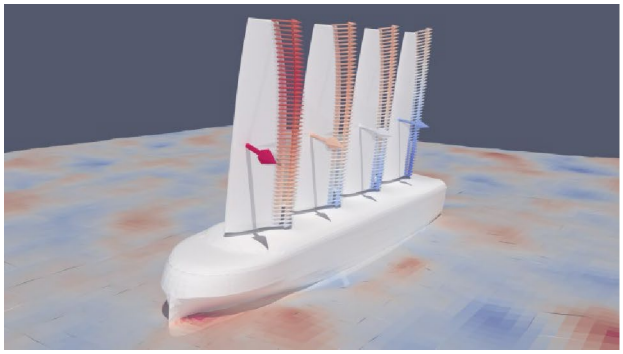
Application
Please apply by sending your CV, references, and a short letter describing your background to Professor Henrik Aronsson (Henrik.aronsson@bioenv.gu.se)

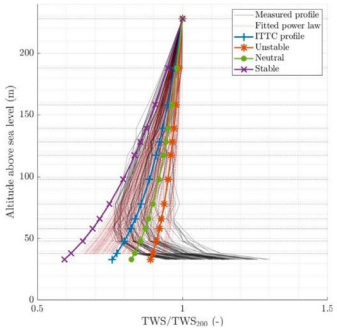
6. Earth Sciences

Classification of wind profiles for the design of wind-propelled ships

Suitable for a 45-60 hp MSs project

Contact person: Lorenzo Minola, Department of Earth Sciences, University of Gothenburg, lorenzo.minola@gu.se





Nowadays about 90% of the goods are transported by sea, making the shipping industry responsible for 3% of the global greenhouse gases emissions (as much as the total emissions of a country like Germany). Among the different technologies being developed to reduce ships' emissions, the most promising is **wind propulsion**, where wind is used either for reducing the fuel consumption or as propulsor of the vessel.

In order to be able to design such new technology, it is crucial to understand the characteristics of winds at the sea. For this reason, a testing campaign was carried out by KTH Kungliga Tekniska Högskolan. This campaign recorded wind profiles of four Atlantic crossings via a LiDAR sensor installed on a car carrier ship.

In this project, you will have access to these unique measurements and you will work towards the understanding of the main characteristics of the wind profiles over the North Atlantic Ocean. With this aim, you will not only analyse wind measurements recorded during the campaign, but you will also compare them with the newest wind profiles measured by satellites from the Aeolus mission of the European Space Agency.

This project is in collaboration with SSPA (https://www.sspa.se/en) and you will work together with them. You will be part of a mixed team, with experts from the field of meteorology to the naval engineering. The results of your thesis will be used by SSPA for improving the design of wind-propelled ships: this will help in shaping a more sustainable future.

Please, contact us if you have any questions or you are interested in knowing more about the project!

Requirements: It is preferable if you have basic programming skills (e.g., able to work in Matlab or Phyton environment) and a basic knowledge of meteorological processes.

Main-supervisor:*Lorenzo Minola*, Lorenzo Minola, Department of Earth Sciences, University of Gothenburg, Gothenburg, lorenzo.minola@gu.se

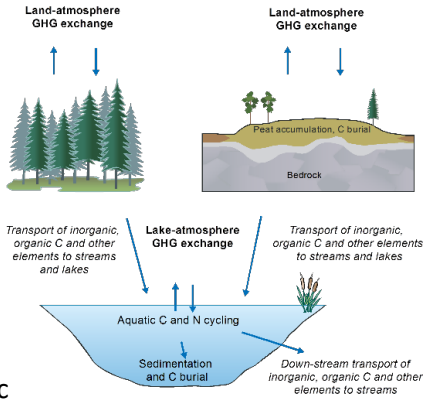
Co-supervisors:

Laura Marimon Giovannetti, SSPA, Gothenburg, Laura.MarimonGiovannetti@sspa.se

Chiara Wielgosz, SSPA, Gothenburg, Chiara.Wiegosz@sspa.se

Alessandro Pezzoli, Interuniversity Department of Regional and Urban Studies and Planning, Turin, alessandro.pezzoli@polito.it

Thesis projects at "Skogaryd Research Catchment"



At the Skogaryd Research Catchment (SRC,https://www.gu.se/en/earth-sciences/skogaryd-research- catchment-0) we study greenhouse gas fluxes and mattertransport on a landscape level, investigating the land-atmosphere, land-water, and water-atmosphere exchange. Thecatchment consists of various ecosystems: mires, forests ondifferent soils, lakes and streams.

At SRC we can offer several thesis topics, both for BSc and for MSc level. Do not hesitate to contact us if you have some own idea.

Assessing carbon stocks in forest ecosystems

Forests play an important role for climate ch
carbon, both in the living treesand in the soil
abovegroundbiomass. Different types of fore
carbon stock. We are establishing aforest ma
with selectionharvest. Prior to management,
Topics that can be addressed combined or in

- **Carbon and nutrients stocks in the soil**. Sys
analyses of carbon and nutrients, to provide
- **Past growth of the trees**. Tree cores sampling
ring width. Influence of climate can also be st
- **Water chemistry**: we have an extensive netw
flow and nutrient concentrations.

Contact person: Tobias Rütting (tobias.rutting@gu.se)

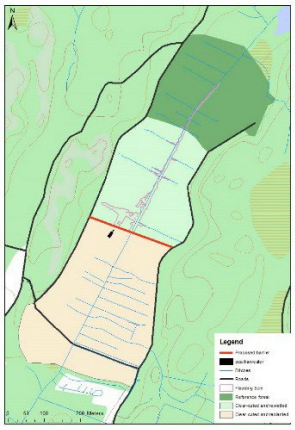
Assessing soil carbon stock and greenhouse gas emissions from drained and rewettedpeatland

MSc project: In a world of climate change we need to minimize greenhouse gas (GHG) emissions and instead accumulate carbon in ecosystems - we call this 'negative emissions'. Forests growing on drained peatland soil are in many cases large sources of GHG emissions, but a rewetting of the former peatlandcan turn the balance from emissions to uptake. At SRC a spruce forest (plantation) on drained peat soil was clear-cut in 2019 and one part of the site will be rewetted, while the other part

replanted withspruce (business-as – usual). Emissions of GHG are monitored at the site. Complementary projects available:

- **Nutrient status and availability and soil carbon stocks**. We will use soil C to N ratio to estimateN2O emissions, a strong GHG that is usually difficult to quantify annual budgets for due to hightemporal variation.
- **Laboratory experiment for quantifying gross nutrient turnover**. Using soil samples in the laband isotope techniques (stable isotope ^{15}N and/or radioisotopes ^{33}P).

Contact person: Louise Andresen (louise.andresen@gu.se)



Future nutrient limitations across ecosystems

Soil fertility and nutrient availability are among the most important resources. As ecosystemsage, nitrogen (N) accumulates in soil through biological fixation, whereas available phosphorus (P) is depleted from the soil through mineral weathering and occlusion during pedogenesis, therefore a shift from N to P limitation progress globally at long term.

Nutrient limitation threatens plant growth and food and fodder production as a consequence of **climate change and elevated atmospheric CO_2**. With a deeper empiric understanding of the changing dynamics of the macro nutrients N and P in response to futureclimate change, we want to enable predictions of nutrient limitations or richness for a given ecosystem such as grassland, tropical forest or Swedish forest.

Methods: isotope techniques to determine if N or P limitation is present and possiblyshifting in a natural terrestrial ecosystem, by measuring gross N and P mineralization rates and N depolymerization rate. Rocks and geological material can be analyzed for N, P and NH_4 leaching.

Contact person: Louise C. Andresen louise.andresen@gu.se

Urban Climate Group, Department of Earth Sciences, University of Gothenburg

CityAirSim - Visualising and modelling urban air quality - influence of vegetation, buildingmorphology and traffic emissions

A large consortium of partners is currently involved in the research project CityAirSim whichaims to investigate and communicate how dense and green urban environments affect air quality. This specific master thesis project is a collaboration between IVL and the Göteborg Urban Climate Group. The overall purpose of this thesis will be to take part in the examination of how different types of vegetation, building designs and emission scenarios affect air quality around Fabriksgatan in Göteborg. This will be accomplished by a modellingapproach using the LES model PALM (https://palm.muk.uni-hannover.de/trac). The studentwill use PALM to calculate the dispersion of particles and nitrogen dioxide for different hypothetical development scenarios for Fabriksgatan. The student will thereafter analyze the effect of the different scenarios on air flow and air quality.

This master project gives the student the opportunity to gain experience working with an advanced modelling system and to learn about the dynamics of air quality in an urban environment. The work within CityAirSim will result in a series of scientific publications and the student will therefore be encouraged to produce high quality results fit for publication.

Research focus:

- the influence of the urban geometry, urban vegetation and land cover on radiation, temperature, humidity and wind
- spatial modeling and measurements of the thermal comfort conditions in urbanenvironments
- the influence of weather on urban daily life (outdoor activities, place perception),health and well-being
- integration of climate knowledge in urban design and planning
- development user-friendly planning toolsOverall Summary of CityAirSim

An important future goal is to create sustainable, green and dense urban environments. To ensure good air quality it is crucial to understand how vegetation, denser building structureand future traffic situations, separately and in combination, affect air quality. Our aim is to create tools for identification, visualisation and communication of measures promoting urban air quality with respect to vegetation, buildings and traffic. We will address these questions: How does densification, urban vegetation and traffic affect air quality? How can this type of environmental data visualised and communicated to increase understanding and engagement among citizens, city planners and people working with urban environments? This is achieved by 1) identification and quantification of processes governing the effect of plants on air quality by uptake of pollutants, increased deposition and altered ventilation, 2) integration of relevant vegetation processes in a model for dispersion of air pollutants and application of the model on relevant scenarios, 3) development of tools for digital visualisation of model results representing the urban landscape, and 4) communication for the public, education and as a tool in city planning.
This transdisciplinary project links biological and meteorological knowledge with state-of- the-art visualisation and communication in collaboration with stakeholders and supports therealisation of UN sustainability goal 11 – Sustainable Cities and Communities.
https://www.mistraurbanfutures.org/sv/projekt/cityairsim-ska-visa-hur-trafik-gronska-och- tatt-byggande-paverkar-stadsluften

Contact persons: Sofia Thorsson sofia.thorsson@gvc.gu.se, Fredrik Lindbergfredrikl@gvc.gu.se

It is preferable if the student have basic programming skills and experience of working in aLinux environment.

Contact persons: Fredrik Lindberg, GU, fredrikl@gvc.gu.se , Malin Gustafsson, IVL, malin.gustafsson@ivl.se

Future nutrient limitations across ecosystems

Soil fertility and nutrient availability are among the most important resources. As ecosystemsage, nitrogen (N) accumulates in soil through biological fixation, whereas available phosphorus (P) is depleted from the soil through mineral weathering and occlusion during paedogenesis, therefore a shift from N to P limitation progress globally at long term.

Nutrient limitation threatens plant growth and food and fodder production as a consequence of **climate change and elevated atmospheric CO2**. With a deeper empiric understanding of the changing dynamics of the macro nutrients N and P in response to futureclimate change, we want to enable predictions of nutrient limitations or richness for a given ecosystem such as grassland, tropical forest or Swedish forest.

Methods: isotope techniques to determine if N or P limitation is present and possiblyshifting in a natural terrestrial ecosystem, by measuring gross N and P mineralization rates and N depolymerization rate. Rocks and geological material will be analyzed for N, P and NH_4 leaching.

Contact person: Louise C. Andresen louise.andresen@gu.seHomepage: https://gvc.gu.se/english

Alpine and Polar Ecology group

We have the opportunity to offer possibilities to conduct BSs or MSc degree project focusingon the Arctic with potential fieldwork for MSc projects during summertime 2022 in the Scandes. Below is a selection of projects that might be of interest:

1. Within the project “Importance of trophic interactions for mycorrhizal dynamics across the Arctic” we address how deciduous shrubs (being ectomycorrhizal; EcM) have contrasting implication for carbon (C) dynamics than evergreen shrubs (being ericoid mycorrhizal; ErM) by disentangling these mycorrhizal dissimilarities in combination with decadal responses of shrubs to browsing exclusion. We collaborateacross the Arctic and have samples from 13 sites located from Utqiagvik (Alaska, US) in the west to Erkuta (Yamal, Russia) in the east. Thus, specifically we can offer projects aiming to:

a. investigate how shrub browsing controls soil characteristics (e.g. soil organic matter content, pH, ^{13}C, ^{15}N, total organic C/N, NH_4^+ and NO_3^- content). This isa laboratory-based project and depending on the type of degree project, it can be delimited in different ways.

b. Climate trends and conditions for the 13 project sites. You will assemble climate data from different databases and determine the current climateconditions and recent trend in climate. Depending on the type of degree project, it can be delimited in different ways.

c. investigate how shrub browsing controls the production and turnover of extramatrical mycelia (EMM) biomass using ingrowth mesh bags. You will useergosterol, a proxy for living biomass, and

chitin content, a proxy for total EMM dry matter (biomass + necromass), to estimate production, whereas turnover will be estimated using exponential decay modelling. This is a laboratory-based project and depending on the type of degree project, it can be delimited in different ways.

d. develop a method to disentangle mycorrhizal types for estimating EMM production. You will develop a technique that combines extractions of ergosterol, chitin and phospholipid fatty acid (PLFA). PLFAs are essential membrane components of living cells, and because phospholipids rapidly degrade following cell death, they are excellent biomarkers of viable microorganisms. Furthermore, some PLFAs are useful biomarkers of specific microbial groups (e.g. fungi and bacteria), and provide information on the dynamics of microbial communities. The fatty acids of interest for this projectare 18:2ω6c and 18:1ω9 that are used as biomarkers for fungi and 16:1ω5c and 20:1ω9c used as biomarkers for arbuscular mycorrhizae (AM fungi). This is a laboratory-based MSc-project.
e. investigate how shrub browsing control plant traits of deciduous and evergreen shrubs. You will harvest full individuals of deciduous shrub dwarf

birch (*Betula nana*) and evergreen shrub crowberry (*Empetrum nigrum*) at two sites in the Scandes (Ritsem and Grövelsjön) to determine both root and shoot traits (e.g. fine root $^{15}N/^{13}C$ content, leaf N content, dendrochronology,mycorrhizal colonization). This is both a field- and laboratory-based MSc- project with fieldwork late august 2022.

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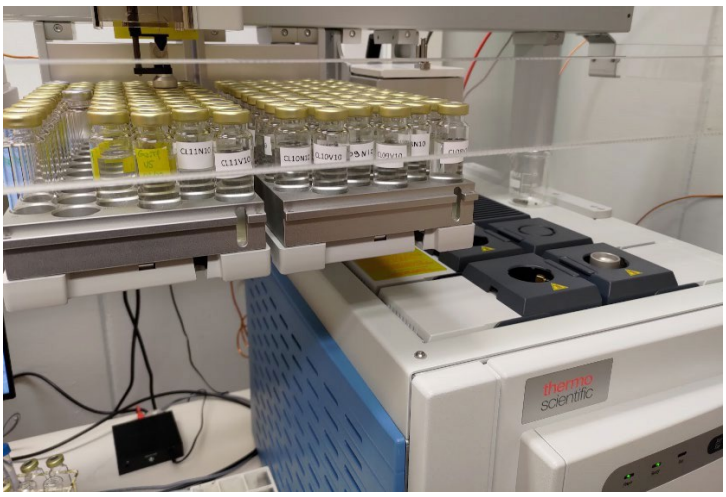
University of Gothenburg, Department of Earth Sciences

7. Environmental Sciences

Let's take a closer look at greenhouse gas emissions from aquatic environments

Level: MSc (30, 45 or 60hp) Subject: Aquatic Biogeochemistry Contact: Assist. Prof. Stefano Bonaglia (stefano.bonaglia@gu.se)

General theory



Nitrous oxide (N_2O) and methane (CH_4) are major greenhouse gases (GHG) and their atmospheric concentrations have increased by ~22 and ~160%, respectively, compared to pre-industrial times. Yet, it remains challenging to quantify their emissions from the sea, leading to large uncertainties in global budgets. It is also unclear how widespread coastal eutrophication and de-oxygenation enhance marine N_2O and CH_4 emissions.

Project description

This project will quantify overlooked fluxes of N_2O and CH_4 from sensitive aquatic ecosystems. The targeted environments may include coastal lagoons, fjords, and other pristine or anthropogenically impacted aquatic ecosystems in Europe. Depending on the thesis' credits (30, 45 or 60hp), the Master student will either work on previously collected samples or join ongoing research cruises to be carried out at monitoring sites in Sweden (By Fjord, Gullmars Fjord, etc.), in Lithuania (Curonian

Lagoon), in Poland (Vistula Lagoon), in Germany (Szczecin Lagoon), and elsewhere. The project may involve collaboration with colleagues at BioEnv, at Marines, and at external universities.

Student tasks and outcomes

The Master student will learn how to perform N_2O and CH_4 analyses on a newly acquired, high-precision gas chromatographer located in our GU laboratories at Botan. The student will also perform data analyses and interpretation. This project is expected to expand scientific knowledge on coastal ocean greenhouse gas fluxes, and reveal if eutrophication acts as positive feedback reinforcing climate change.

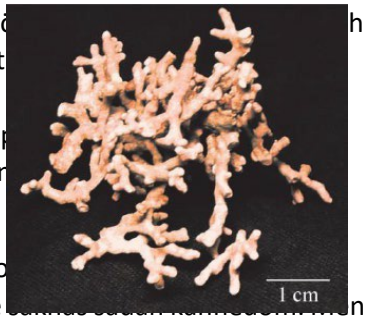
Contact: Assist. Prof. Stefano Bonaglia (stefano.bonaglia@gu.se)

Svenska maerlbäddar - Förekomst, ekosystemtjänstfunktion och miljöpåverkan

Projektledare: Lina Rasmusson (Biologi och Miljövetenskap GU) och Tom Staveley (SLU Aqua)

Kontakta: lina.rasmusson@bioenv.gu.se

Förekomsten och betydelsen av maerlbäddar, bentiska marina livsmilj h döda kalkinlagrande rödalger, är högst okänd i svenska vatten. Habitat mångfald och är betydelsefulla för klimatreglering och fiskrekrytering. flera viktiga ekosystemtjänster. På grund av deras känslighet för antrop långsamma tillväxthastigheter är dessa alger hotade och deras utbredn runtom i världen.



På många håll i Europa har man bra kunskap om hur stora maerlföreko bra koll på vilken funktion de har i det marina landskapet men i Sverige n det ska vi ändra på genom att fastställa förekomsten, betydelsen och sårbarheten för dessa biogena rev i svenska vatten. Och du kan vara med på detta uppdrag!

Vi erbjuder en glad och engagerad arbetsmiljö med möjligheter till arbete på lab eller i fält, framför datorn med dataanalys eller med litteraturstudier, lite efter vad din kompetens och dina intressen ligger. Vi är alltid öppna för diskussioner om vad du tänker att du skulle vilja göra. Vi kommer ha projekt på master- och kandidatnivå, samt möjlighet till projektarbete, inom tre olika huvudinriktningar.

Kartläggning och modellering av levande och döda maerlförekomster.

Detta är grundbulten i projektet och består i att sammanställa befintliga data på maerlförekomster från olika databaser och litteratur samt från ett pågående medborgarforskningsprojekt. Detta är en viktig del i sig men kommer också ligga till grund för attfå fram en bild av vilka abiotiska faktorer som styr maerletablering vilket kan användas för att ta fram GIS underlag för att spåra nya förekomster. Underlaget från kartläggning och modellering kommer användas för att bestämma områden som kommer besökas och inventeras i fält med undervattensvideo och ROV.

För att passa i detta projekt måste du ha god kunskap i GIS.

Maerlets bidrag till marina ekosystemtjänster

Här finns det en uppsjö av ämnen att undersöka. Ett stort fokus kommer ligga på den marina biodiversiteten där direkt inventering av floran och faunan kommer utföras genom video/ROV transekter. Då maerl är viktiga habitat för många grävande organismer som gärna lever i revstrukturerna så kommer även infaunan inventeras. Fiskförekomster kommer registreras med BRUV för att direkt se vilka arter som spenderar tid i maerlbäddarna. eDNA för fisk kommer analyseras i maerlförekomsterna men också i närliggande habitat för att försöka fastställa hur viktiga habitat maerl är för fisk.

Då maerl är kalcifierare och fotosyntetiserare har de stor inverkan på balansen av oorganiskt kol. Denna balans ska vi titta närmare på gärna med inslag av hur den kan tänkas ändras i och med potentiella miljöförändringar.

Fysiologiska effekter av miljöpåverkan

Maerl är fascinerande och komplexa livsformer. Då de är uppbyggda av kalk så har de en struktur som är väldigt känslig för exempelvis mekanisk skada och havsförsurning. Även andra förändringari havsmiljön som temperatur, salthalt, ljustillgång och näringshalter, framför allt i kombination, kan ha effekt på algernas välmående. Genom olika experimentuppställningar och teknikerkommer påverkan på fotosyntes, respiration, kalcifiering och tillväxt undersökas, detta för att ge en inblick i hur algerna fungerar i dagens och framtidens hav.

Dessa experiment är tänkta att utföras på Kristineberg Center för marin forskning och innovation.

Kontakta: lina.rasmusson@bioenv.gu.se

MSc Characterization of contaminants of emerging concern in coastal waters

Level: Masters project

Subject: Marine Chemistry

Project Description: This project focuses on characterizing contaminants of emerging concern (CECS), which includes compounds such as pharmaceuticals and pesticides, in coastal waters. The project may include field collection and analysis of CECs in groundwater, surface water, and other environmental matrices. Specific project details and scope, such as study site and compounds analyzed can be narrowed to match research interests. There are also potential opportunities to participate in a research cruise or fieldwork in France in the spring.

Background: CECs have been gaining increasing attention by scientists, policymakers, and the general public in recent years, but much is still unknown about the environmental fate of these compounds or the scale of environmental impact. These compounds are environmentally pervasive and negative impacts to marine life have been demonstrated even in trace quantities. Most CEC studies to date focus on CECs in fresh waters, wastewater treatment plants, or drinking water, so there is a huge opportunity to get involved with this kind of research in understudied environments. Research results may also lead to better understanding of pollutant source(s) of chronic water quality problems in natural waters.

Contact: Trista McKenzie (trista.mckenzie@gu.se)

Preliminära examensarbetsförslag *(omfattning 15, 30, 45, 60 hp)*
Earliest Autumn 2023

1) Utvärdera vilka åtgärder som är mest relevanta i Sverige för att motverka plast i hav-problemet. Olika perspektiv, en medborgares, privata aktörers perspektiv (inkl ICA), en lokal politikers, en nationell politikers och en NGO:s perspektiv. Mycket baserat på IVL:s stora rapport från 2016, men också andra studier internationellt och i Sverige. Är plastkasseförbud eller liknande relevant, eller ett spel för gallerierna? Studien skall underbyggas med beräkningar, och stödjas av litteratur, osv.

En minskning av NOx-utsläpp förbättrar folkhälsan.

Detta borde kunna översättas i pengar för staten? Kan staten använda denna möjliga ”vinst” för att sätta in styrmedel för att styra från diesel till el inom transportsektorn. Att samtidigt lösa två problem, dvs NOX- hälsa och klimat, skulle ju kunna löna sig? Även problem med buller och troposfäriskt ozonminskas, och där finns också en del att tjäna. Kan staten göra något som är

kostnadseffektivt? Investera för lägre kostnader i framtiden? Lönsam investering?

2) Konsumtionstrender? Elbilar går allt bättre. Finns fler goda exempel, men en hel del går också sämre. Hur ser det ut? Varför? Kommentera också rebound effects, indirekta och evdirekta. Eller tom på samhällsnivå.
Hur hanterar vi olika konsumtionstrender med styrmedel idag och hur skulle man kunnaagera, på svensk nivå och på EU-nivå. Grön upphandling – en förändringsfaktor? Jämförmed andra länder! Några bra initiativ utanför Sverige som vi kan ta efter? Översätt till svenska förhållanden.

3) Det finns idag s.k. Carbon Offset-system. Man köper t.ex. utsläppsrättigheter, eller investerar i CDM-projekt i Indien. Om/när vattenfrågan slår till globalt sett på bred front, skulle man kunna ha nytta av ett motsvarande Water offset-system? Hur skulle ett sådant system kunna utformas? Kan t.ex. HM eller klädkonsumenter bidra till vattenbristmotverkande åtgärder, för att kompensera för sin direkta och indirekta vattenkonsumtion. Vattenfrågan har dock en lokal dimension. Kan den hanteras i ett sådantsystem? Dessutom, varför är det som himla billigt att klimatkompensera? Hur fungerar klimatkompensation när vi börjar närma oss nollutsläppen. När upphör det att vara en bra idé, osv. Jämför med ett ev. Water offsetsystem: Kommer det att vara billigt eller dyrt? Finns det motsvarande situation som när koldioxiden närmar sig nollutsläpp?

4) Nu byggs det som aldrig förr. Dessa byggnationer bestämmer miljöprestandan för ganskalång tid, energiförbrukning, osv. Även lokala miljöer i städer, inkl buller. I vilken mån byggs passivhus, osv. Missas miljöperspektiven i hastigheten? Förbereder vi boendet för ett det framtida sättet att leva; sharing, nya sätt att transportera oss, avancerad avfallshantering, förändrade konsumtionsmönster, …?

5 a) Drönare inom Miljöområdet. Sammanställning, samt minst tre egna nya idéer, som diskuteras.

6 b) Big data inom Miljöområdet. Sammanställning, samt minst tre egna nya idéer, somdiskuteras.

7) Försök kvantifiera miljönyttan av några varianter av cirkulär ekonom; sharing av olika slag,nya transportsätt, funktionsförsäljning, cascading, …

8) Tidsaspekter av biobränsleanvändning 30 år på oss, biobränsle från skogen 100 år? Hur ska vi optimera biomassaanvändningen i ett 30-100 års-perspektiv. Ev. även markanvändning.

9) Klimatmål av olika slag 2045, 2030, osv. Är vi på väg ? GAP-analys. Goda exempel! Vad gör andra länder - goda exempel? Finns det andra aktörer än länder som satt upp egna mål (kommuner, regioner, företag, städer, etc.) Är det mer ”walk the talk” för dessa aktörer? Finns det sätt att skal upp dessa till större skala. Föreslå konkreta åtgärder på ett strukturerat sätt och beskriv ”barriers and drivers” för förslagen!

10) Jämför GU:s utfall i praktiska spörsmål med andra universitet och liknande. Föreslå konkreta åtgärder på ett strukturerat sätt och beskriv ”barriers and drivers” för förslagen! Internationella goda exempel på åtgärder vid universitet! Hur skulle GU kunna ta efter?

Contact person: Dan Strömberg, dan.strömberg@bioenv.gu.se
(on sick leave spring 2023)

5. Project via Holohouse (former Miljöbron)

Read more here for updates https://holohouse.se/

6. Projekt vid Lilla Edets kommun inom miljö och hälsoskydd samt naturvård

Miljö och hälsoskydd - diverse

- **Kiselalger som indikation på miljökvalitet i vattendrag med avseende på näring och miljögifter.** Hur kan inventering och analys av kiselalger hjälpa oss i att prioritera var miljöåtgärder ger bäst effekt? Vilken information kan vi få fram om vattendragens ekologiska status?

- **Enskilda avlopp och lokal påverkan på små vattendrag.** Miljötillsyn på enskilda avlopp är ofta baserad på schablonberäkningar. För att prioritera rätt åtgärder på rätt plats vore det intressant att fokusera på ett lokalt avrinningsområde och genom återkommande provtagning över en längre säsong utreda tänkbara påverkanskällor och hur de varierar över säsongen.

- **Inomhuseldning – vilka miljö- och hälsoskyddsproblem kan kopplas till småskalig eldning och hur ser det ut i kommunen.** Enligt nya riktlinjer för luftvård från naturvårdsverket ska beräkningar göras för utsläpp från vedeldning. Hur många eldar med gamla vedpannor, olja och vilka har gått över till pellets för uppvärmning? Vilka faktorer påverkar valet av uppvärmningssystem och hur påverkas omgivningen?

- **Flygaska från Essity i vägbyggen – Hur påverkar askvägar vattenmiljöer i närheten.** I Lilla Edet har man anlagt olika typer av vägar, oftast skogsbilvägar, med hjälp av flygaska som är en biprodukt från tillverkningen vid pappersbruket i kommunen. Initialt sker en kraftig höjning av pH, men långsiktig studie av påverkan på naturmiljön kring dessa askvägar kontra vägar anlagda med makadamkross saknas.

- **Hållbar samhällsplanering -** Uppföljning av översiktsplan: Kommunens översiktsplan antogs 2012. Den anger i vilka områden som vår nybyggnation främst ska ske, samt att utvecklingen ska ske med hänsyn till hållbara transporter, värdefull natur med mera. Inför revidering vore det givande med en uppföljning: En sammanställning av de bygglov som getts sedan översiktsplanen antogs, med en analys av ifall bebyggelseutvecklingen i sin helhet har följt ÖP:s intentioner. (Du får gärna ha GIS-kunskaper. Inspiration kan hämtas bland annat från denna rapport.)

Miljöenheten på Lilla Edets kommun tar i mån av tid gärna emot dig som vill genomföra ett examensarbete på en liten kommun. Vi har många idéer på intressanta projekt – men studenten behöver själv vara drivande i att ta fram lämpliga frågeställningar och utforma projektet i enlighet med kraven på ett naturvetenskapligt examensarbete från lärosätet.

Projekten kan utformas som Master-, kandidat- eller verksamhetsförlagda projekt.

Kontaktpersoner:

Anna Tauson, Kommunekolog, Sektor Samhälle. Anna.tauson@lillaedet.se
Besöksadress: Järnvägsgatan 12. Postadress: Lilla Edets kommun, 463 80 Lilla Edet

Naturvård - diverse

- **Kommunala naturvårdsplaner –** hur väl fungerar de? I vilken omfattning kan utpekande i kommunala strategiska dokument så som översiktsplan, fördjupad översiktsplan och naturvårdsplan skydda värdefull natur mot exploatering? Genom att kartlägga exploatering eller annan landskapsförändring över de senaste 15-20 åren i polygoner som pekats ut i den kommunala naturvårdsplanen och jämföra mot exploateringstakt och landskapsförändring i övrigt kan vi få en indikation på hur effektivt de strategiska dokumenten, som är politiskt antagna, faktiskt fungerar. Varför/varför inte?

- **Återinventering av utvalda naturvårdsobjekt i kommunens naturvårdsplan.** Mycket av inventeringsunderlaget som legat till grund för objektskatalogen i den kommunala naturvårdsplanen baseras på gamla inventeringar från 80- och 90-tal. Ett tänkbart projekt är att välja ut en särskild naturtyp och genomföra återinventering för att kartlägga vilka förändringar som har skett. Det är t.ex. sannolikt att flera öppna betes- och hagmarker har vuxit igen. Projektet kombinerar med fördel ortofotoanalys med fältbesök.

- **Inventering av skyddsvärda ekar, uppföljning.** Under sommaren 2021 gjordes genom ett exjobb en återinventering av samtliga kända skyddsvärda ekar i kommunen. Tillgängliga data från den inventeringen är stamomkrets, ålder, konkurrens & beskuggning (täckningsgrad av övrig vegetation) hål, förekomst av efterträdare, vitalitet & markanvändning. Denna information kan användas för att göra ytterligare studier, exempelvis på förekomsten av nyckelarter beroende på grad av beskuggning.

- **Inventering av jättebalsamin.** Arten jättebalsamin är listad på EU:s förteckning över invasiva främmande arter. Att det finns jättebalsamin i Lilla Edets kommun är känt men det saknas kartläggning över förekomsterna. Ett möjligt projekt skulle kunna gå ut på att inventera förekomsten och identifiera spridningsrisken och hotbilden gentemot inhemska arter, samt föreslå lämpliga bekämpningsåtgärder.

- **Undersökning av bekämpningsmetoder mot parkslide.** Växtfysiologi/växtmorfologi. Projektet utförs lämpligen över en längre period, maj-september. På kommunens grönytor har förekomst av den invasiva arten parkslide ökat. Parkslide är en svårbekämpad art och bekämpningen kan bli mycket kostsam och/eller långdragen. Vilken metod som är den ”bästa” finns det ännu inget svar på. En tänkbar studie kan inledas med en omvärldsstudie

och som experimentdel t.ex. utvärdera en specifik bekämpning på ett bestånd över en säsong, med avseende på tillväxt av rot och ovanjordsdelar. Studiens resultat kan vara vägledande för kommunen när bekämpning är lämpligt och vilken typ av bekämpning som kan vara lämplig – och vad man inte ska göra. Arbetet kan i så fall inledas med en omvärldsstudie och sammanställning av bekämpningsmetoder och rådande kunskapsläge. Sedan följer du olika bestånd som bekämpas under sommarperioden och mäter återväxt/spridning med någon vetenskaplig metod, och jämför hur bestånden reagerar på olika typer av ingrepp.

- **Inventering av vattenvegetationen i Öresjö –** uppföljning på strandinventeringar (hydroliterala) utförda 1991, 1998, 2005, och 2012 på 6 olika transekter längs Öresjös stränder. Då noterades artförekomst och antal, vegetationens yttersta gräns, markanvändning m.m enligt inventeringsmetodik ”BV750”. Ett möjligt projekt kan innebära en återinventering av ytorna och en analys av förändring i vattenvegetationen.

- **Hållbar samhällsplanering -** Uppföljning av översiktsplan: Kommunens översiktsplan antogs 2012. Den anger i vilka områden som vår nybyggnation främst ska ske, samt att utvecklingen ska ske med hänsyn till hållbara transporter, värdefull natur med mera. Inför revidering vore det givande med en uppföljning: En sammanställning av de bygglov som getts sedan översiktsplanen antogs, med en analys av ifall bebyggelseutvecklingen i sin helhet har följt ÖP:s intentioner. (Du får gärna ha GIS-kunskaper. Inspiration kan hämtas bland annat från denna rapport.)

Miljöenheten på Lilla Edets kommun tar i mån av tid gärna emot dig som vill genomföra ett examensarbete på en liten kommun. Vi har många idéer på intressanta projekt – men studenten behöver själv vara drivande i att ta fram lämpliga frågeställningar och utforma projektet i enlighet med kraven på ett naturvetenskapligt examensarbete från lärosätet.

Projekten kan utformas som Master-, kandidat- eller verksamhetsförlagda projekt.

Kontaktpersoner: Anna Tauson extern handledare (se nedan) och Johan Höjesjö intern handledare (johan.hojesjo@bioenv.gu.se).
Anna Tauson, Kommunekolog, Miljöenheten. Anna.tauson@lillaedet.se
Besöksadress: Järnvägsgatan 12. Postadress: Lilla Edets kommun, 463 80 Lilla Edet

7. Examensarbeten inom Stadsmiljöförvaltningen i Göteborg

These projects are described in Swedish since the projects will require extensive reading,writing and speaking in Swedish, and are best suited for Swedish speakers.

Göteborg är en stad med målsättning att både växa och vara hållbar, detta såväl ur ett miljömässigt som socialt perspektiv. Enligt gällande mål och strategier ska det i Göteborg finnas en mångfald av olika naturtyper och arter. Staden har också som mål att öka kunskapoch medvetenhet om vad som krävs för en hållbar framtid. Stadens gröna områden ska aktivt förvaltas och skötas för att gynna ett rikt växt- och djurliv

och ekosystemtjänster. Stadsmiljöförvaltningen i Göteborg ansvarar för förvaltning av stadens gröna områden. Denna lista beskriver vilka examensarbeten (kandidat och magister) eller verksamhetsförlagda projekt, som kan genomföras. Samtliga genomförs iförsta hand på svenska.

Kontaktpersoner: Linda Thelin, linda.thelin@stadsmiljo.goteborg.se (extern handledare: zoolog Slottsskogen, Stadsmiljöförvaltningen i Göteborg), och, Jenny Klingberg, jenny.klingberg@bioenv.gu.se (intern handledare: forskare, föreståndare för GGBC).

Undersökning om kunskap och värdering av ekosystemtjänster i Slottsskogen

Biologisk mångfald är helt avgörande för en hållbar framtid. Det finns en stor enighet bland forskare och beslutsfattare att allmänhetens kunskap om vikten av biologisk mångfald behöver öka för att det ska vara möjligt att uppnå de internationella och nationella målen kring minskad förlust av biologisk mångfald. Forskning visar samtidigt att människors egna erfarenheter av naturen formar värderingar som är starkt styrande för individens beteendeoch eventuella värnande av arter/miljö.

Denna studie syftar till att kartlägga hur väl parkens besökare känner till och värderar de ekosystemtjänster som Slottsskogen står för. Resultatet kan användas för att utveckla Slottsskogens arbete med att utveckla och framhäva parkens ekosystemtjänster. Studien genomförs genom intervjuer och/eller enkäter.

8. Examensarbeten och praktik vid Länsstyrelsen i Västra Götaland

Övergripande kontaktperson: klara.jansson@lansstyrelsen.se

Främmande arter med hög risk för invasivitet i trädgårdsbranschen

Invasiva främmande arter är ett av de största hoten mot biologisk mångfald globalt och lokalt. En stor del av arterna härstammar från trädgårdarna och trädgårdsbranschen. Vi vill undersöka försäljningsmönster och inställning i Västra Götaland. Frågeställningar kan exempelvis vara: Vilka riskklassade arter (enligt ArtDatabankens risklista) finns idag till försäljning i länet? Vilken spridning har de? Finns intresse för byte till arter med mindre risk för invasivitet i branschen? **Typ:** kandidat eller master

Område: Hela länet

Kontakt: Klara Jansson, klara.jansson@lansstyrelsen.se, 010-224 48 92