Institute of Environmental Sciences (CML)
Department of Conservation Biology (CB)
Internship possibilities 2017-2018

Dear student,

This is the updated list 2015-2016 of possible internships at the department of Conservation Biology of the Institute of Environmental Sciences (CML). We have deliberately chosen for a simple presentation, most projects have, a title a short description and the supervisor name and contact information, as we try to define the definite content of the projects with the students themselves.

The projects are divided according to the different scale levels at which our department operates:

Populations:

- Individual species and populations in interaction with anthropogenic threats are the focus here

Ecosystems and communities:

- Species communities in relation to the functioning of ecosystem and their interactions are the focus here. In most topics, we evaluate its functioning in relation to human impacts

Biodiversity and ecosystem services:

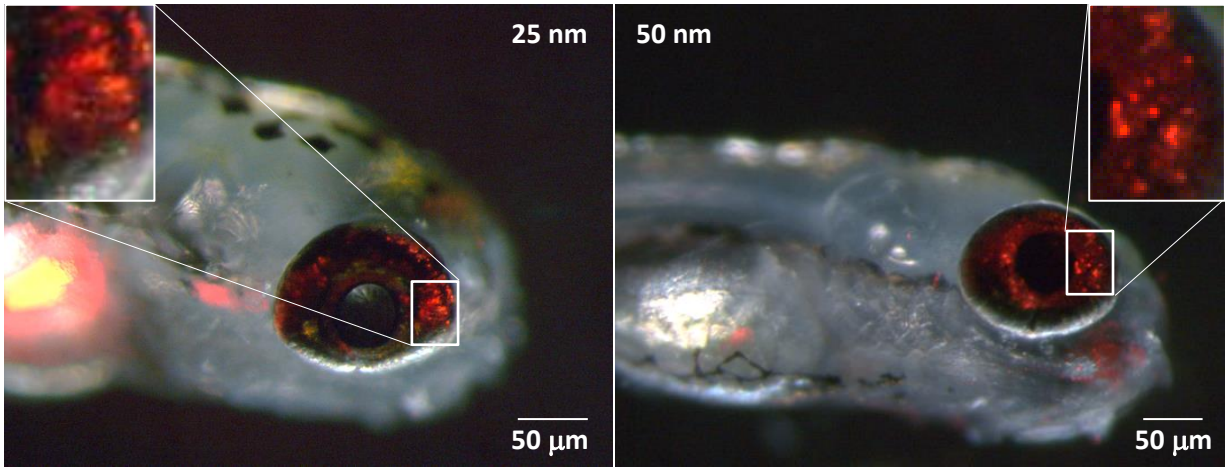
- Drivers of regional and global biodiversity patterns; conservation and predictions;
- The services provided by ecosystems, interactions with human needs and the role biodiversity plays in providing services for human kind are the focus here

You can get more information from the CML-instructors or students present at the stand or contact the appropriate supervisor through e-mail or by phone. If you are interested in another or related environmental internship, you can also discuss that with your potential supervisor. For MSc-students it is also possible to do an internship externally outside the Leiden University, with additional supervision by CML. For general questions, please contact:

Krijn Trimbos: tel. 7457, e-mail trimbos@cml.leidenuniv.nl

Populations

Visualizing the uptake, biodistribution and effects of nanomaterials



Rubbish in the environment, we all know that it doesn't belongs there. Pictures of dead birds who died from stomachs filled with plastic, we've all seen them. But what if the plastics breaks down in

small pieces? Even in particles we can't see with the naked eye: nanoparticles? Can birds or fish still die from it? Can these particles enter our body? What we found until now, is that size is really important. If the particles are small enough (ca. 50nm or smaller), they can enter the body and even accumulate in the eye. But size is only one aspect of nanoparticles, so there is much more to discover. Who joins us in this quest?!

Highlights of our previous study – published in Aquatic Toxicology
DOI: 10.1016/j.aquatox.2017.06.017
• Only uptake (across epidermis) observed for particles smaller than 50 nm
• Small particles were detected to have biodistribution and even ended up in the eye
• Uptake of particles via chorion and epidermis is marginal
• Uptake should be monitored to provide more in depth toxicity information
Supervisor: MSc. Marinda van Pomeren, m.van.pomeren@cml.leidenuniv.nl, tel. 1494.

Abundances of mycorrhizal fungi in soil. MSc or BSc project
Mycorrhizas are mutualistic associations between soil fungi and plants, where the host plant receives nutrients and water from the fungi and, in exchange, the fungi obtains carbon compounds from the plant. Mycorrhizal associations play a key role in terrestrial ecosystems functioning, influencing plant community composition, soil structure, and biogeochemical cycles. Despite its recognized importance for ecosystem functioning, little is known about the real abundance of mycorrhizas in soils, how this abundance is distributed in different biomes and the environmental factors that can control the distribution patterns. In this project you will investigate these questions using advance analytical techniques (such us Phospholipid Fatty Acid Method) and analyzing global datasets. This project also includes lab work in Lund University (Sweden).
Supervisors: MSc. Milagros Barceló, m.barcelo@cml.leidenuniv.nl, tel. 4917.
Dr. Nadia Soudzilovskaia, n.a.soudzilovskaia@cml.leidenuniv.nl, tel. 7485.
Period: Starting from January-February

Monitoring the effect of daily water use efficiency and deficits saline agriculture
Predictions of population growth indicate an increase in water and agricultural requirements. At the moment food production already uses 11 percent of all the land and 70 percent of all available fresh water. In contrast sea-water has only been used sparsely in agricultural practices, although it represents 87% of the total available water. In response, research has been performed into the salt-water irrigation in test facility for saline agriculture on Texel . In this facility, biomass of different crops is investigated for different fresh-sea water concentrations. The water use efficiency (WUE) of a crop, i.e. the amount of water needed to produce 1 kg biomass, is an important determinant of the final yield of crops. For saline agriculture, WUE is only known from the lab, and only at coarse temporal resolution. In this project, we intend to perform actual Evapotranspiration measurements (using the bowen ratio method), to provide daily estimations of the water stress and water use efficiency and the impact on the total yield.
Supervisors: Dr.ir. Joris Timmermans, j.timmermans@cml.leidenuniv.nl, tel. 2727.
Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel. 7486

Towards using TLS measurements for deriving leaf angle distributions
Leaf angle distributions (functions) (LIDF) are of high importance for the architecture of a plant and hence for its entire functioning. Hence, information on this property is critical in remote sensing applications, for which these leaf angle distributions are estimated a priori on basis of ground measurements. However, measuring leaf angles for different vegetation types is very time-

consuming, and poorly known despite its prominent role. In this view, terrestrial laserscanning (TLS) might provide a tool to greatly speed-up this effort. A TLS system shoots light pulses and measures the time that it takes for the reflection to be measured. By recording not only the time, but also the pointing angle as well as its own position very accurately, a TLS is capable of creation a (billion) point-cloud representing the canopy. Afterwards a 3D-reconstruction of the trees can be performed. In this project, we would like to investigate how a TLS system can be used together with traditional measurements to improve estimates of LIDF. This project therefore will require on-site fieldwork (in either woodland/forested regions).

Supervisors: Dr.ir. Joris Timmermans, j.timmermans@cml.leidenuniv.nl, tel. 2727.
Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel. 7486.
Prof. dr. Koos Biesmeijer, j.c.biesmeijer@cml.leidenuniv.nl, tel. 5650
MSc. Amie Corbin, a.e.corbin@cml.leidenuniv.nl

Using eDNA to survey the critically endangered Philippine crocodile

The Philippine crocodile *Crocodylus mindorensis* is a relatively small freshwater crocodile endemic to the Philippines. Previously widely distributed on all major islands of the Philippines except Palawan, this species is now extremely rare and restricted to southwestern Mindanao and northern Luzon. The total wild population is estimated at less than 250 mature individuals (van Weerd 2010). The Philippine crocodile is listed as critically endangered (IUCN 2016). However, a lot is still unknown about their current distribution because surveys outside of their known distribution are expensive and often difficult due to infrastructural problems while the chances of locating crocodiles is often very low. New methods to improve the accuracy of crocodile surveys, and the identification of Philippine crocodile localities, will help in prioritizing field research and conservation of what is probably the World's rarest crocodilian species. eDNA is DNA that an organism leaves behind in the environment, via shed skin, hair, feces or other organic sources. Environmental DNA can overcome some of the drawbacks of morphological surveys, since only a water sample theoretically needs to be taken at a few locations along the river banks to determine the presence of the Philippine crocodile assuming that it is present and sheds DNA on a regular basis. Using eDNA techniques we aim to get a better picture of the current distribution of this threatened reptile species. Additionally, we want to compare observational surveys with eDNA surveys to validate eDNA as tool for conservation projects of critically endangered species. The MSc student will have opportunities for field research in the Phillipines, data and literature studies within this topic.

Supervisors: Dr. Krijn Trimbos, trimbos@cml.leidenuniv.nl, tel. 7457.
Drs. Merlijn van Weerd, merlijnvanweerd@yahoo.com

What's in the diet: Copy number biases in DNA-based quantification

If a plant protection product indicates a potential risk in the first Tier approach for birds and mammals a more realistic scenario should be sought to quantify this risk. A reconsideration of the actual exposure is essential, which includes a better understanding of the proportion of the treated food item in the diet of the relevant species. In this project the Wood Mouse (*Apodemus sylvaticus*) diet will be examined. Currently this is mostly done by sampling of feces and analysis of these feces under the microscope. Due to different digestion rates of different food items in the intestinal tract of the animals, conversion factors are used; these conversion factors, however, do only exist for some species. The method remains time consuming and in some cases imprecise, especially if it comes to small seeds of which the remains are very difficult to detect and quantify in the feces, if detected at all. If assessing the uptake of a seed treatment product, however, a precise quantification of the ingested seeds is essential. An establishment of quantitative DNA analysis might solve this issue. This topic involves different side projects for which we can use both BSc and MSc students:

1. **The influence of copy number variation on the quantification of seeds in the Wood Mouse diet**

New emerging technologies make it easier to detect low quantities of DNA in environmental samples. As a result, it is possible to study an animal's diet using DNA-based approaches on feces samples. Furthermore, these techniques hold the promise to relate the DNA concentration of food items to the amount of food eaten by the organism through DNA quantification. This would give fundamental insight into food availability and preference, which are both essential in improving strategies for biodiversity conservation. However, there are several challenges facing diet quantification using molecular techniques. One of these challenges is the so called copy number variation bias. Cells can contain mitochondrial DNA and/or plastid DNA (in plants) and nuclear (genomic) DNA. Each of these sources of DNA has a different amount of copies per cell. E.g. nuclear DNA has only one copy per cell. However, mitochondrial and plastid DNA can have a copy-number of up to 1000 copies. When regarding quantification, this difference in copy number within cell organelles can undermine reliable quantification of diet components. This project will investigate the differences between single-copy and multiple-copy DNA-based quantification of wheat (*T. aestivum*) in wood mouse feces. This study will entail literature study, extensive primer design and laboratory work using state of the art quantification techniques (droplet digital PCR).

Supervisors: Dr. Krijn Trimbos, Trimbos@cml.leidenuniv.nl, tel. 7457.
MSc. Kevin Groen, k.groen@cml.leidenuniv.nl, tel. 5631.

2. **Small seed quantification in wood mice feces by quantitative DNA analysis**

This project involves live trapping of wood mice in the field and collecting their droppings. Subsequently, in the laboratory DNA from these droppings will be extracted. Previously constructed quantitative DNA protocols and conversion factors, between food composition intake and DNA of the food items in the feces, will be used to determine the relative amount of food items eaten with special focus on carrot and onion seeds. Field work will take place in Germany. Currently, we are unsure when the fieldwork will take place therefore it is unclear during what period this internship can be conducted next year. However, if you are interested and are relatively flexible in terms of when you can start your internship please contact us.

Supervisors: Dr. Krijn Trimbos, Trimbos@cml.leidenuniv.nl, tel. 7457.
MSc. Kevin Groen, k.groen@cml.leidenuniv.nl, tel. 5631.

Hunting impacts on Buffalo conservation

In many places hunting is the main source of income supporting conservation areas. When managed well, and conducted ethically, hunting can be an important part of conservation efforts. As one of the big 5, buffalo are one of the more desirable game species for hunters. In particular, buffalo bulls are hunted as a trophy species. The most desirable bulls, for hunters, are those with the largest spread of horns. The spread is the measurement, in a straight line, from outside edge to outside edge of the horn curves. A spread of 40 inches and above is considered a trophy. These bulls fetch the greatest prices and opportunities to hunt them are sold on a quota basis. This is usually determined as a percentage of the total population.

Traditionally hunters have looked to hunt younger trophy bulls, with fewer scars, and sharper horn tips (these get worn over time). This means these bulls have reduced opportunity to pass on the genes for a wide horn spread. Therefore, in the focus area, it is becoming increasingly difficult to find bulls with the desired spread. Whilst this result has not been empirically tested, initial data shows a decrease in horn spread over time. This decrease has been recognized by some in the conservation sector who have initiated a new hunting protocol in the area. The new protocol says that you may only hunt trophy bulls if they are over the age of 12. This means they are well passed breeding prime and have had a full reproductive life, during which they can pass on their large horn genes. However, there is no data on how many buffalo bulls survive to the age of 12.

Using aerial photography from a lights sports aircraft and automated computer assessment we will survey the entire buffalo population of the APNR (a number of private reserves adjacent to, and unfenced with, Kruger National Park) and the buffalo population of a similarly sized section of

Kruger. We will describe the demographics of the buffalo bulls to determine the number surviving to old age (over 12). We will also compare horn spread in a hunting area vs a non hunting area to assess any long term impacts of hunting on buffalo trophy sizes and spread of these impacts into other adjoining areas.'

Supervisors: Dr. Maarten Schrama, m.j.j.schrama@cml.leidenuniv.nl, tel. 5652.

Ecosystems and Communities

Unravelling mosquito based freshwater food webs in South African ponds

Mosquitoes are disease vectors for a wide range of pathogens. Yet we have a very limited understanding of the natural enemies of mosquitoes. Recent studies have shown that, especially in the larval stage, enemies can have a tremendous effect on larval populations. This knowledge is highly relevant, particularly for biodiversity conservation of freshwater macrofauna species such as dragonflies, beetles and backswimmers. However, it is currently unknown which feeding links exist in natural food webs, especially in the tropics where mosquitoes are the most important vector for infectious diseases. In this research the student will use a combination of field collections, small scale mesocosm experiments (both carried out mostly in South Africa) as well as molecular techniques (qPCR assays, carried out at the Naturalis lab) to detect which mosquito species are consumed by which predator species.

Supervisors: Dr. KD Dijkstra, kd.dijkstra@naturalis.nl
Dr. Maarten Schrama, m.j.j.schrama@cml.leidenuniv.nl, tel. 5652.

Taxonomic and ecological survey of the mosquito fauna of the Dutch Caribbean

Despite almost no fresh surface water, several diseases spread by mosquitoes occur in the Dutch Caribbean (St Eustatius, Saba and Bonaire). However, the mosquito fauna has not been surveyed since 20 species were found 60 years ago. We want to find out which species occur in the region and in what habitats they are found, so we have a baseline of potential mosquito-borne disease hazards in the region. The survey uses traditional trapping of adults and larvae but will also trial detection with environmental DNA in water samples, while identifications will be made using both morphological and genetic characters. In this research the student will use a combination of field collections (the targeted island will be determined by urgency and access following Hurricane Irma) as well as taxonomic study and molecular techniques carried out at the Naturalis lab.

Supervisors: Dr. KD Dijkstra, kd.dijkstra@naturalis.nl
Dr. Maarten Schrama, m.j.j.schrama@cml.leidenuniv.nl, tel. 5652.

Impacts of temperature and light on plant phenology and communities

A growing human population and urbanisation have led to an increased use of artificial light. Extensive use of artificial light at night (ALAN) has resulted in 83% of the world's population living under light-polluted skies. Plants sense day length (photoperiod), and use this information, in combination with other cues such as temperature, to time phases like budburst, flowering and leaf fall. ALAN can increase perceived day length, and hence may affect the phenology and fitness of plants. Additionally, climatic warming tends to advance the phenology of many plant species. The timing of phenological events in turn affects insect and other communities, so we aim to better understand the extent and relative importance of these human-induced changes. There are opportunities for field, data and literature studies within this topic.

Supervisor: Dr. Ellen Cieraad, e.cieraad@cml.leidenuniv.nl, tel. 7484.

Impacts of dairy farming on diversity of soil biota. MSc project

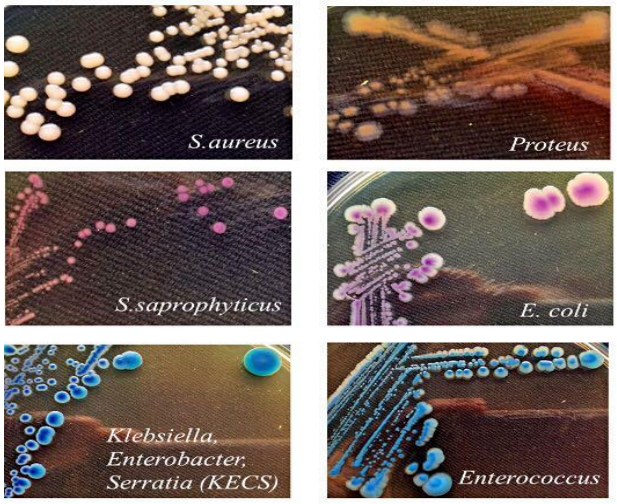
Dairy farming is among the principally important agricultural sectors in The Netherlands, whereby grassland is with 1 million hectares is the biggest crop. However, grassland renewal and cultivation of maize for animal feeding affects soil quality. How does dairy farming affects soil biota and therewith ecosystem services potentially provided by soil, remains poorly understood. Also the impacts of soil type on the soil quality alterations introduced by dairy farming is unknown, retarding developing policy measures aimed at maximisation of ecosystem services provision in agricultural soils. In this study the student will examine the soil quality of grassland and arable land on dairy farmers distributed over the dominant soil types in The Netherlands (peat, clay and sand). Using molecular genetic methods you will examine structure and diversity of soil biota communities, which in combination with measurements of chemical and physical soil quality parameters provides necessary basis to estimate impacts of dairy farming on soil quality.

Supervisors: Dr. Nadia Soudzilovskaia, n.a.soudzilovskaia@cml.leidenuniv.nl, tel. 7485.

Effect of nanoparticles on intestinal microbiota and gut-associated immune responses

Nanoparticles have been widely applied due to their antibacterial activity. Given the wide and increasing application, nanoparticles from waste effluent or deposition are finding their way into aquatic and terrestrial environment. Important knowledge has been gained about the uptake of nanoparticles on various organisms. However, extraintestinal organ uptake and fitness damage are not the final destination, nanoparticles can also enter the gastrointestinal digestion system, which will subsequently alter gut microbiota, affected the gut-associated immunity and cause perturbation on the host. Our previous study found that nanoparticles altered the metabolic function of intestinal microbiota, hinting that the exposure preferentially selects gut bacteria that are resistant to nanoparticles as a result of competitive advantages. Therefore, the aim of this project is to 1) determine the competition advantages of selected gut bacterial strains under the exposure to nanoparticles. 2) to quantify gut immune system as a defense against nanoparticles. Gut bacterial strains have been separated and purified. The student will be introduced into beetle gut extraction and exposure, and will learn how to conduct bacterial strains study as well as cutting-edge molecular techniques. The analysis of the data requires comprehensive thinking, connecting effects at bacterial level with observed adverse effects at organism level. Collaboration and supervision among Institute of Environmental Science (CML) and Institute of Biology Leiden (IBL) are available for students participating in this project.

Supervisors: MSc. Yujia Zhai, y.zhai@cml.leidenuniv.nl, tel. 1476.
Dr. Ellard Hunting, e.r.hunting@cml.leidenuniv.nl, tel. 7475.
Dr. Daniel Rozen, d.e.rozen@biology.leidenuniv.nl, tel. 7990.
Dr. Martina Vijver: vijver@cml.leidenuniv.nl
Prof.dr. Willie Peijnenburg: willie.peijnenburg@rivm.nl



Gut bacterial strains in

Decomposition rate of mycorrhizal fungi and impacts on soil carbon sequestration. MSc or BSc project

Soil carbon sequestration is an important but hardly understood mechanism counterbalancing atmospheric CO_2 emissions and thereby climate change. An important biotic determinant of soil carbon transformations is mycorrhiza, a plant-fungal symbiosis featured by nearly all vascular plants on Earth. Mycorrhizae have different forms, among which arbuscular and ectomycorrhiza (AM and EM) are the most wide-spread. Growing evidence suggests that vegetation stands featuring either mycorrhizal type differently relate to principle aspects of belowground carbon accumulation processes. Growing evidence suggests that decomposition of mycorrhizal fungi themselves might be an important source of C sequestration in soil. However, little is known about the rate of fungal decomposition in soil. In this project you will examine how distinct mycorrhizal fungi differ in decomposition rate.

Supervisor: Dr. Nadia Soudzilovskaia, n.a.soudzilovskaia@cml.leidenuniv.nl, tel. 7485.

Remote sensing of (sub-)arctic biodiversity.

Arctic and subarctic ecosystems are vulnerable systems that need to be protected, and in order to do so we need a better understanding of their spatial biodiversity patterns. This project is about using remote sensing data (hyperspectral data gathered from UAVs (drones)) to quantify functional (traits-based) biodiversity. Spectral data and trait data will be gathered, and together these will be used to create a remote sensing model.

A student project within this project could focus on various aspect of the overarching project; such as modeling diversity of a trait, modeling trait means, creating diversity maps, traits in relation to environmental variables, or trait diversity in different climates.

There is room for one or two master students in this project. It includes fieldwork in Abisko, Sweden, or Ny-Ålesund, Svalbard (Norway). The fieldwork is carried out during the summer, somewhere within the months of june-august.

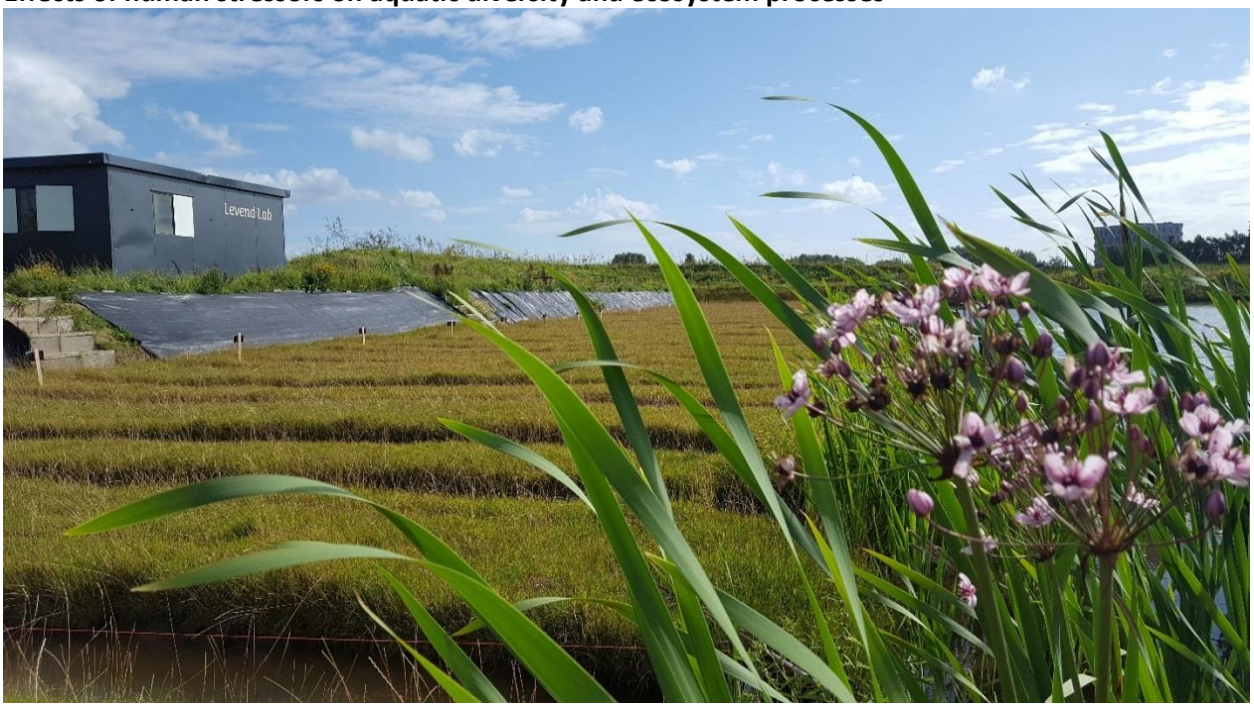
Supervisors: MSc. E.M. de Goede, e.m.de.goede@cml.leidenuniv.nl, tel. 5645.
Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel. 7486.

Can we determine species density through DNA measurements; understanding the influence of DNA shedding on environmental DNA concentrations within aquatic environments.

Global biodiversity is facing a major crisis, which makes ecological monitoring studies ever more important, to facilitate science-based effective management of biodiversity. A highly promising recent development to overcome current problems with community-wide sampling strategies, on the basis of morphology, is to assess environmental DNA (eDNA). This technique is based on the fact that all species lose cells containing DNA to the environment they live in. While eDNA has been used to determine species presence/absence, its next level application to evaluate species densities is still in its infancy; it is still unclear how eDNA concentration truly relates to species abundance and biomass. Different species might be present in the same amount but might still show higher eDNA concentrations than other species due to higher DNA production patterns. For instance species with an exoskeleton are expected to show a lower speed of eDNA production in the aquatic environment than species without an exoskeleton, since exoskeletons form a natural barrier between the cells containing the DNA and the aquatic environment. The rate at which DNA of a certain species builds up in the environment might also depend on how fast they move/how active they are/how high their metabolic rate is. For this research line we aim at developing a generic and comprehensive approach for determining species community composition freshwater environments. The research will include laboratory live set ups using water tanks and possibly artificially constructed ditches and ponds (mesocosms) with several freshwater macrofaunal species and molecular DNA work (extractions, PCR). To do this we need several BSc or MSc students for studying eDNA production in different freshwater macrofaunal species.

Supervisor: Dr. K.B. Trimbos, trimbos@cml.leidenuniv.nl, tel. 7457.

Effects of human stressors on aquatic diversity and ecosystem processes



Understanding how existing and emerging human stressors can potentially affect our natural environment and the organisms living therein is essential to protect our environment. While the basic idea is straightforward, attaining such reliable estimates on the fate of ecosystems proved to be challenging and, to date, did not provide the means to tackle ongoing declines in biodiversity.

So far, studies aiming to resolve impacts of stressors on biodiversity largely focused on a limited number of stressors and organisms in simple laboratory settings. While this provides useful data, it is difficult to extrapolate these results to the natural environments. This is because in the natural environment a number of additional effects can alter the impact of human stressors. For example, toxic stress and predation both affect an individual's performance and these stressors might interact. Or, in contrast, a food surplus via nutrient loads in aquatic systems might reduce toxic stress. These interactions are heavily understudied as most studies focus on restricted ecosystem compartments, while human pressures likely extend beyond the boundaries of an ecosystem.

In order to increase ecological realism of research focusing on these possible interactions, we built a new outdoor testing facility, called the Living Lab (www.facebook.com/levendlab, www.levendlab.com). Through the natural character of 38 adjacent ditches, we can test the effect of anthropogenic stressors on a community level.

We currently have a number of projects that aim to unravel the effects of human stressors on aquatic diversity and ecosystem processes:

1) Large scale field experiments. In order to detect shifts in species composition, trait distribution and food webs. And to monitor species' fitness via *in situ* (such as cages) experiments.

2) Outdoor mesocosm experiment to determine functional responses of aquatic communities in a semi-realistic field setting.

If necessary, these project can be complemented by indoor laboratory microcosm experiments. In order to reveal the underlying mechanisms of how human stressors affect certain species and determine small-scale interactions.

We aim to understand the effects of agricultural land use and practices (e.g. pesticide application) on the biology of adjacent drainage ditches. Students participating in these projects will contribute to conceptualization, experimental work in both field and laboratory and data analysis, in which there is plenty of room for students to pursue their own interest.

Supervisors: MSc Henrik Barmentlo, s.h.barmentlo@cml.leidenuniv.nl, tel. 5610.
Dr. Maarten Schrama, m.j.j.schrama@cml.leidenuniv.nl, tel. 7481.
Dr. C.J.M. Musters, musters@cml.leidenuniv.nl, tel. 5618.
Dr.ing. Martina Vijver, vijver@cml.leidenuniv.nl, tel 1487.

Fate and behaviour of nanoparticles in natural waters with different chemical properties
Currently, many products are consist engineered nanoparticles (NPs) for a better functionality or quality. However, the widespread use of these NPs is giving rise to the release of many of them to the environment with possible serious ecological consequences not fully understood yet. Water, natural vehicle for pollutant migration, is one of the compartments in ecosystems affected by the release of these NPs, which come mainly from industrial and urban wastewater discharges and runoff.
In general, the fate and behaviour of NPs in aquatic environments are determined by aggregation, sedimentation and dissolution processes. Understanding these processes and their dynamics is of importance, since these processes have a decisive impact in the mobility and bioavailability of these NPs and, hence in their toxicity in the aquatic systems.
The fate and behaviour of NPs in aquatic systems depend on water physico-chemical characteristics such as pH, temperature, ionic strength, salinity and presence of organic matter and divalent ions such as Ca^{2+} and Mg^{2+}; and also to the size, specific surface area and chemical reactivity NPs. The objective of this project is investigates the effects of different environmental water on the physicochemical properties of nanoparticles with the objectives to understand their fate and behaviour and how water parameters may modify NPs and influence in their dissolution, aggregation and sedimentation over time.
To investigate the influence of water characteristics (pH, electrolyte concentration and DOC content, etc.) on the fate and behaviour of NPs, environmental water samples with different properties will be sampled. Different exposure water suspensions will be prepared with NPs and motorised to study changes in NPs over time. Water samples will be collected to measure size distribution, zeta-potential, total and ion NP concentrations (and indirectly particle concentrations) at different times. Aggregation, sedimentation and dissolution processes of NPs will be studied by modelling with the results obtained.
Supervisors: Dr. Daniel Arenas, d.arenas.lago@umail.leidenuniv.nl, tel. 1482.
Dr.ing. Martina Vijver, vijver@cml.leidenuniv.nl, tel 1487.

Biodiversity and Ecosystem Services

Ecosystem management to optimize ecosystem services. MSc Internship
Most ecosystems, be it in The Netherlands or abroad, are either managed intensively by humans or strongly influenced by human activity. The concept of ecosystem services can inform on the consequences of different approaches towards managing and designing ecosystems and landscapes. But which ecosystem services do you gain or lose with conservation or restoration, and does a more nature-based or sustainable approach towards ecosystem management also generate more and higher quality ecosystem services?

To answer such questions, a systematic indicator-based research approach is needed, as well as in-depth knowledge on the ecological variables that underpin ecosystem services and societal variables that determine the demand or use of these services.
Potential case studies for this challenging and interdisciplinary research include: coastal ecosystems influenced by ecological engineering (the Sand Motor / Dutch dunes / Negril beach, Jamaica), aquatic ecosystems in the Netherlands, urban ecosystems and global-scale studies.
Fieldwork cannot always be guaranteed, desktop study can also be an option. Please note that the availability of internship opportunities depends on whether there are concrete questions that require further research. The final case study will be agreed on with the student.

MSC-internship. Students should have a genuine interest in interdisciplinary research and experience with embedding research in the wider societal context.
Supervisors: Dr. Alexander van Oudenhoven, a.p.e.van.oudenhoven@cml.leidenuniv.nl, tel 7473.
Prof.dr.ir. Peter van bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel 7486.

The effects of biodiversity on Drought resilience/resistance
It has been well established that a high level of biodiversity increases the resilience of ecosystems to anthropogenic disasters and viral outbreaks. In part this is caused because the effects of such disruptive events are varied for the different species and different plant functioning. Consequently these ensure that the total impact is much lower than in the case of mono-culture ecosystems. It has been shown that this is indeed in the case of natural (ecological) disasters such as droughts and flooding a similar resistance plays a role (1). This study however has been performed using very coarse resolution (60kmx60km) drought information and only for grasslands. During this research we would like to investigate this at higher resolution, using different remote sensing observations to characterize drought (such as soil moisture and evapotranspiration) and plant functional biodiversity (such as LAI, chlorophyll,…).
Supervisors: Dr.ir. Joris Timmermans j.timmermans@cml.leidenuniv.nl, tel 2727.
MSc. Leon Hauser, l.t.hauser@cml.leidenuniv.nl, tel 5649.

Identifying global and local trends from long term Climate Data Records (CDR) for Remote Sensing
The Global Climate Observing System (GCOS) has designated many Essential Climate Variables (ECVs) which are open and available for long-term datasets. These variables vary from leaf area index, to snow cover, hydrology, soil moisture, radiation, etc. (https://goo.gl/R4gHpK). A large amount of this data has yet to be related to plant traits which could aid in their retrieval and improve remote sensing applications. In this project, you would be looking at global long-term datasets to discover trends of ECVs and look at direct and in-direct relationships with plant trait data.
This project is available for both an MSc and BSc student.
Supervisors: Dr.ir. Joris Timmermans j.timmermans@cml.leidenuniv.nl, tel 2727.
MSc Amie Corbin, a.e.corbin@cml.leidenuniv.nl
Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, 7486.

Evaluation of traits retrieval from different Remote Sensing models in evergreen forests
There are many different models used for remote sensing applications in retrieving information about forests. When considering plant traits as a source of quantifying the status of forests, often remote sensing uses radiative transfer models (RTMs). Some are developed specifically for needle bearing trees, others are more general or for broad-leaved forests. However, the most commonly used model, PROSPECT, is developed for broadleaf forests. Despite this, it is used for almost all global products, even though more specific models exist. Previously, students have collected plant trait data

from Speulderbos, The Netherlands and Sodankylä, Finland. You will use this data to investigate and compare the performance of these remote sensing models on different species.
This project is open for a BSc or MSc student.
Supervisors: MSc Amie Corbin, a.e.corbin@cml.leidenuniv.nl
Dr.ir. Joris Timmermans j.timmermans@cml.leidenuniv.nl, tel 2727.
Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, 7486.

Oil palm plantations and its impacts on biodiversity
In collaboration with Universitas Indonesia, we aim to make oil palm plantations more sustainable. We don't think the tropical rainforest will return if we manage oil palm plantations more sustainably, but we believe that nature can be served by a better management of oil palm plantations. During this thesis, you will perform field research in collaboration with Universitas Indonesia on either a. an evaluation of impacts of oil palm plantations and the extent to which they are managed sustainably on aquatic biodiversity of nearby streams. We will employ environmental DNA analysis in combination with field surveys to quantify biodiversity patterns. or b. an analysis of bird biodiversity in and near oil palm plantations and their ecological functions in oil palm plantations. With that information, measures may be developed to optimize bird biodiversity and particular bird biodiversity associated to ''good'' functions for oil palm plantations.
Supervisor: Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel 7486.

Uncertainty in the temporal dynamics of RS-related plant traits
Plant trait trade-offs have been well defined from an ecological standpoint over the last decade from peak biomass measurements. However, when applying Remote Sensing (RS) applications, many of these well-defined traits are not applicable at RS scales, nor are they detectable or useful. This topic focuses on looking at remotely sensed traits (LAI, chlorophyll, leaf water, etc.) and their dynamics over an entire growing season. Sample collection of various plants will be conducted throughout the growing season and hyperspectral and satellite imagery will be used to create supplementary data.
Projects can focus on:
1) The temporal dynamics of plant traits
2) On the trait trade-off dynamics
3) The retrieval of these traits through remote sensing models
(For other analysis ideas contact the supervisor)
This project requires extensive fieldwork in varying parts of the globe in order to capture the temporal dynamics needed. Fieldwork has so far been conducted in the Netherlands and in Lapland, Finland. Fieldwork is still required in several locations including São Paulo, Brazil, China, and most likely the United States. There is also some possibility to visit the site in Lapland again this year.
This work is available for several MSc students or for exceptional BSc students who follow an internship outside the regular designated period. Time is open depending on location, however it is focused around the peaks of summers in both the Northern and Southern Hemispheres.
Supervisors: MSc Amie Corbin, a.e.corbin@cml.leidenuniv.nl
Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, 7486.

Sustainable ways to cope with extreme precipitation events in agricultural soils
The projected increase in extreme weather events will lead to more extreme rainfall patterns. The climate in Western Europe is projected to become wetter, but is also projected to face longer periods of drought. Already this has led to water management issues: a lack of water during periods of drought and an excess of water during periods of heavy precipitation. Both can be highly damaging to farmers and costly to society. These issues are forecasted to worsen in the decades to come.

Both scenarios call for solutions that aim at increasing water storage. Particularly in the low-lying clay soils of Holland these problems are pressing. Currently, we lack an idea of the type of affordable solutions that are required to deal with these changes.
Therefore, the aim of this project is to evaluate different ways of increasing water holding capacity in agricultural soils using a combined experimental and field approach.
During this six month project, the student will participate in ongoing field-trials, and he/she will set up small-scale experiments at or near the living lab. Because the project is a collaboration between Hoogheemraadschap Rijnland and the CML/University of Leiden, the student will work with both organizations.
Supervisors: Dr. Maarten Schrama, m.j.j.schrama@cml.leidenuniv.nl, tel. 7481.
Bart Schaub, Bart.Schaub@rijnland.net

The happy city hub
The happy city hub (www.gelukkigestad.nl) focus on contemporary urban issues - such as housing, health care, social inclusiveness, mobility, biodiversity and ecology - prepared by the municipality of Rotterdam, the province of South Holland and a variety of organizations from practice. How can we approach those topics with the use of its inhabitants' motivation and involvement? Can solutions next to merely being functional be valuable for people and increase well-being? In the lab we work on new ideas and approaches that contribute to urban transitions from a positive point of view. Within the lab, you work on a multidisciplinary challenge within three universities and operate independently in a versatile network. If you wish so, your solutions can be the starting point for usage in practice.
Supervisor: Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel 7486.

Optimal use of the landscape – a case study in Drente
The province of Drente has a lot of agricultural land of which the productivity is increasingly under pressure. So, the province –co-supervising this thesis- is looking for ways to analyse the benefits of a landscape and to answers to the basic question: How should the government spend its money in landscape management; should it be on agriculture or other land use? How to evaluate the added value of a landscape to other users, for instance, how to determine the additional income due to tourism. (How) Does this provide opportunities for nature? This demands reconsideration of the Dutch landscape, its values and the development of tools for the optimization of its landscape. Similar questions have also been raised by the province of Zuid-Holland and Dunea (the manager of the dunes of Zuid-Holland) and also here a thesis along these lines can be performed.
Supervisor: Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel 7486.

Towards a sustainable ecosystem service provision
Ecosystem services have become the common ground for nature conservation and land management. However, the implementation of ecosystem services is still unresolved. Questions relate to a. how to optimise the provisioning of multiple services simultaneously, while there are clear ecological trade-offs hampering the maximisation of all services. b. can we use traits-based approaches to identify important trade-offs and thus to optimise the provisioning of ecosystem services, and c. the principal problem that any provisioning of a service is highly likely to reduce the capacity of the system for future provisioning of that service. An important question is thus: how may the actual provisioning of ecosystem services allow for a sustainable future provisioning of services? An example is for instance: if you harvest timber, then the future harvesting of timber is reduced and moreover, due to trade-offs, also carbon sequestration may be reduced. In this thesis, you will develop and test a framework to deal with these challenges.
Supervisor: Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel 7486.

How to define soil microbial strategies?
Micro-organisms constitute a substantial proportion of the living biomass in soils. Increasingly, we have information on the identity of soil micro-organisms, we hardly know anything about who is doing what (and when). Moreover, we have no answers to fundamental questions related to the ecological strategies of soil micro-organisms or their functional trade-offs (e.g. what is the functional cost of bacteria that grow fast?). In international collaboration, we have compiled a database of genetic information of hundreds of soil microbial species to which we attached functional attributes. Here, you will evaluate the information available to define fundamental soil microbial strategies.
Supervisor: Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel 7486.

Understanding temporal variability in functional biodiversity
Viewing communities as a collection of traits rather than species, allows ecologists to more closely link biodiversity with ecosystem functions. Functional diversity refers to the range of functions (through their traits) that organisms within a community or ecosystem provide, allowing the system to provide essential services for society that contribute to human well-being and economic value. However, most all of the knowledge we have about functional diversity is applicable to only one part of the year. Insights into how traits and functional diversity fluctuate over an entire growing season will strongly enhance our understanding of diversity, ecosystem resilience, and the services it provides. Field work will involve collecting hyperspectral data with a mounted spectrometer, collecting leaf samples, and ground truth analysis of traits in the lab. Projects can focus on functional diversity, temporal dynamics of plant traits, retrieval of traits through remote sensing, or other ideas in consultation with the supervisor. The tropical location is subject to change and will require an extensive stay (May – August). This work is available for MSc students or for exceptional BSc students who follow an internship outside the regular designated period.
Supervisors: Dr. Rosaleen March, r.g.march@cml.leidenuniv.nl, tel 7497.
Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel 7486.