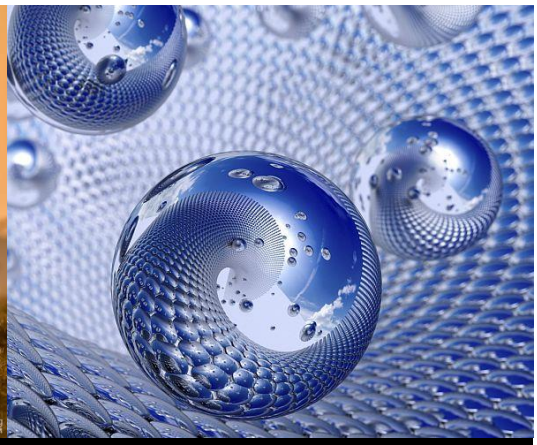
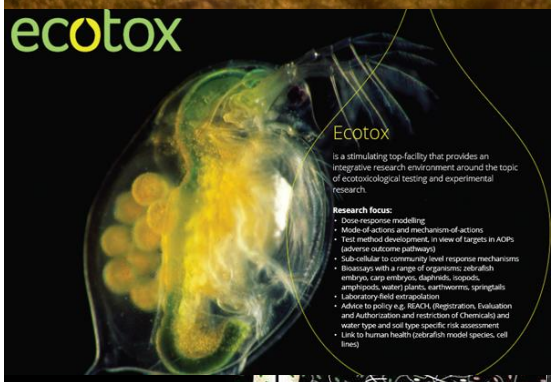
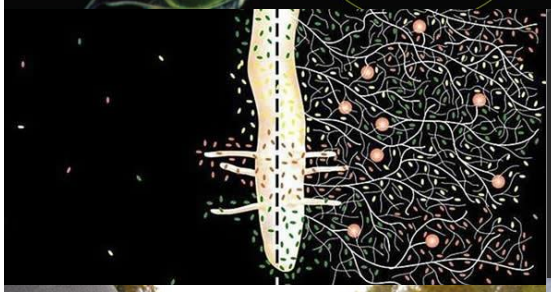
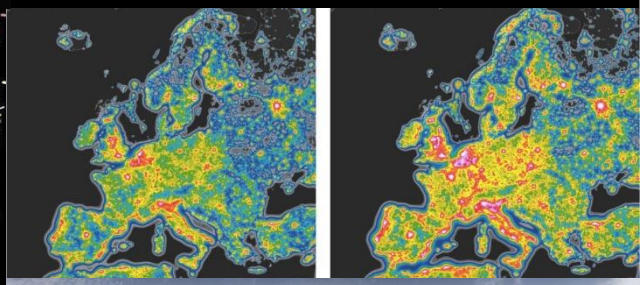
Institute of Environmental Sciences (CML)
Department of Environmental Biology (EB)
Internship possibilities 2018-2019









Dear student,

This is the updated list 2018-2019 of possible internships at the department of Environmental 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

Systematic understanding of bioaccumulation and biodistribution of carbon nanotubes and gold NPs in D. magna and zebrafish at chronic exposure conditions

Nowadays, nanoparticles (NPs) (Figure 1) are not only applied in different industrial activities but they are present in many consumer products such as cosmetic and food products. While the benefits of NPs are widely publicized, the discussion of potential effects on human and in the environment is just beginning. A significant knowledge gap still exists on understanding the toxicological profile of NPs after release in the environment. For example; Are NPs bioavailable to organisms? Do NPs bioaccumulate and biodistribute in internal organs, such as brain, due to their small size and specific design? Are NPs taken up by organisms and transferred in food chains? How do size and shape of NPs influence the mentioned process? The aim of the project is systematic understanding of bioaccumulation and biodistribution of carbon nanotubes and gold NPs in D. magna and zebrafish at chronic exposure conditions. We will investigate whether NPs that are composed of the same core but differ with regard to the shape, size and surface coating also differ with regard to their bioaccumulation and biodistribution.

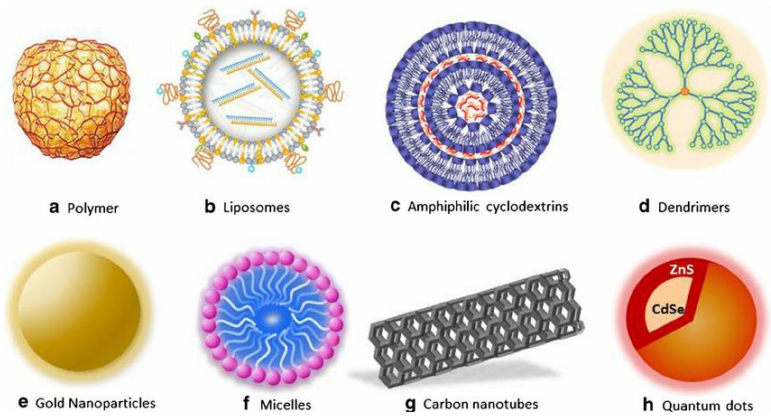
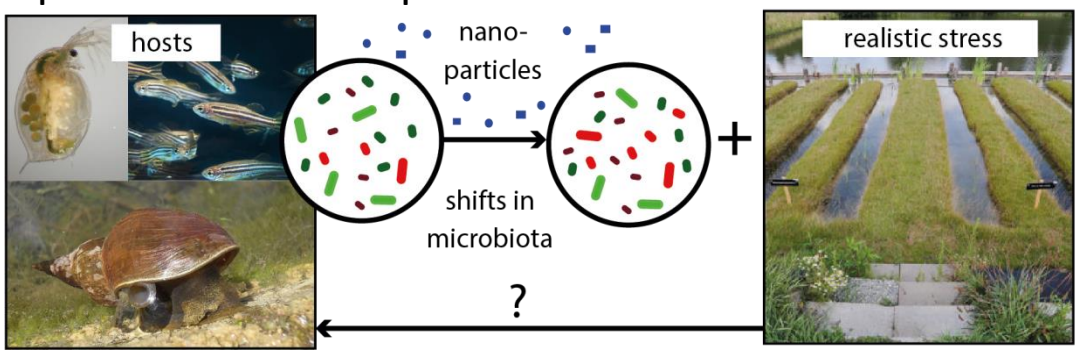


Figure 1: Different types of NPs (adopted from Carthy et al., 2015. Pharmaceutical Research. 32, 4, 1161–1185)

Supervisors: Dr. Fazel A. Monikh, f.a.monikh@cml.leidenuniv.nl, tel. 2096.
Prof. dr. Martina Vijver: vijver@cml.leidenuniv.nl

Period: Starting from January-February 2019

Impacts of antimicrobial nanoparticles on microbiota-host resistance



BSc or MSc project – population (host) to community (microbiota) scale.

Nano-sized particles have unique properties that are applied in an increasing number of products, produced for industrial purposes and consumer use. Because we still don't know how harmful nanoparticles are to the environment, nanoparticles are considered 'emerging chemicals of concern'. Two of the most-used nanoparticles, silver (Ag) and titanium dioxide (TiO_2) nanoparticles, exhibit antimicrobial activity, which has been found to disrupt host-associated microbial communities. Despite the key role of host-associated microbiota to the nutrition, defense, immunity and development of the host, only a few studies have shown that nanoparticle-induced disruption of microbiota resulted in impaired host functioning. This could imply that the disruption of microbiota by nanoparticles does not have a great impact on the environment. However, the concerning studies have characterized host performance under controlled laboratory conditions, without realistic environmental challenges such as competition and the presence of parasites and pathogens. In this internship, you will help increasing the environmental realism of nanomaterial hazard assessment, by testing if disruption of host-associated microbiota by Ag- and TiO_2-nanoparticles impairs the host's resistance to realistic environmental stress. The experimental work will include labwork and could include field sampling. Possible hosts include daphnids, pond snails, and zebrafish embryos, and techniques could include performing standardized ecotoxicological tests, characterizing nanoparticles and microbial communities, obtaining and colonizing germ free hosts (gnotobiotics), fluorescence microscopy, and (dd)-PCR.

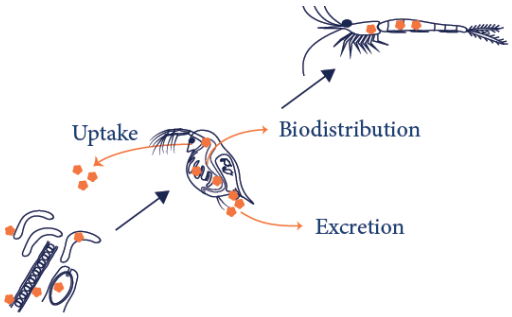
Supervisors: Bregje Brinkmann, MSc. b.w.brinkmann@cml.leidnuniv.nl (daily supervisor).
Prof.dr. Willie Peijnenburg and Prof.dr. Martina Vijver (general supervisors and examiners).

Trophic transfer of engineering nanoparticles in a freshwater food chain

Engineered nanomaterials (ENMs) have already been incorporated into numerous applications, including personal care, health and fitness, electronics, textiles, sports, ceramics, energy, automotive, medicine, agriculture (Gupta et al., 2017). As a major sink for many pollutants, aquatic ecosystems also play important roles in the full life cycle of ENMs due to their intentional and unintentional release (Zhao et al., 2017). The behavior of ENMs in aquatic ecosystems has thus become an urgent issue in view of their risk assessment (Zhao et al., 2017). Once released into the aquatic environment, nanoparticles (NPs) can easily penetrate into organisms due to their ultrafine size (1-100 nm), leading to accumulation and distribution in organisms and possible transfer to other organisms through the food chain (Nel et al., 2006; Lee et al., 2015). The primary aim of the project is therefore to investigate the uptake, distribution and translocation mechanisms, and trophic transfer of ENMs using an aquatic food chain model consisting of algae (*Pseudokirchneriellq subcapitata*), Daphnids (*Daphnia magna*) and shrimp (*Limnomysis benedeni*).

Supervisors: MSc. Qi Yu, q.yu@cml.leidenuniv.nl.
Dr. Thijs Bosker, t.bosker@luc.leidenuniv.nl.
Prof. dr. Martina Vijver: vijver@cml.leidenuniv.nl.
Prof. dr. Willie Peijnenburg: willie.peijnenburg@rivm.nl

Period: Starting after January



Environmental DNA (eDNA). MSc Internship. Several projects.

DNA from environmental samples (eDNA) are now increasingly being used to identify the occurrence of various species within water and soil samples. It is known to be particularly useful in river settings and may be more efficient than visual detection. Since its introduction in the late 2000s, eDNA methods have been refined and expanded to address a range of applications in ecology, evolutionary biology and conservation biology. It is now possible to detect multiple species from a single soil or water sample (metabarcoding). Important steps have been taken to additionally quantify the relative abundance of species. At CML we have several projects using eDNA which investigate effects on ecosystems. One of these projects involves the red swamp crawfish (*Procambarus clarkii*). This invasive species is accused of having a negative ecological and economic impact on the ecosystem. However, there is no data to support this claim. We will investigate among other things if the red swamp crawfish has a negative effect on the community structure and subsequently water quality, by using eDNA. We will use several setups to study red swamp crawfish, including aquaria, mesocosms and (semi) natural settings (living lab). This projects include both field work and laboratory work.

Another project involves the question if eDNA can be usefully employed in the early detection of ecosystem collapse. We will test the hypotheses that river systems such as the Orinoco river system in Venezuela, are top-down controlled by apex predators (river dolphins, giant otters and crocodiles) and

that removal of top predators leads to a strong loss in ecosystem resilience. The field work for this study will be done by local collaborators, but DNA analysis will need to be performed in the Netherlands. As such we are looking for students with at least some basic laboratory skills who are keen on doing labwork and related analysis to run in this project. Students who are interested in either of these projects should have an interest in publishing the results.

Supervisors: Dr. Jolanda Luksenburg, j.a.luksenburg@cml.leidenuniv.nl, tel 7285
Dr. Krijn Trimbos, Trimbos@cml.leidenuniv.nl, tel 7457.

Adverse effects of engineered nanomaterials in freshwater ecosystems

Although the commercial and societal benefits of nanomaterial applications are widely promoted, the potential environmental risks associated with their largescale use are mostly unknown. We investigate how nanomaterial properties such as size, shape and composition can induce and contribute to adverse effects upon exposure in organisms and ecosystems. By developing test setups using realistic exposure methods and ecologically relevant endpoints we aim to obtain predictive results for future emission scenarios.

For this purpose we are looking for students (BSc. or MSc.) who are interested in investigating the ecotoxicological effects of nanomaterial exposure. The research may include laboratory setups using zooplankton and macroinvertebrates, microscopy and molecular DNA work.

For further information, please contact:

Supervisors: Tom Nederstigt t.a.p.nederstigt@cml.ldeidenuniv.nl
Prof. dr. Martina Vijver: vijver@cml.leidenuniv.nl

Ecosystems and Communities

Contributions of Mycorrhizal Fungi to the Soil Carbon Sequestration Processes

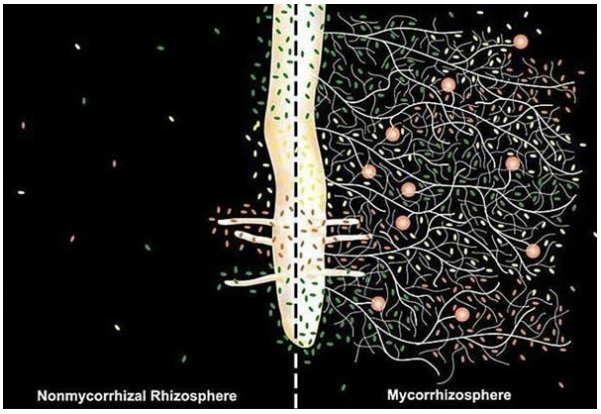
Soil carbon accumulation is to a large extent determined by soil-plant interactions. These interactions have an essential impact on global environmental change and contribute to the feedback of CO2 and other greenhouse gas emissions. Mycorrhizal fungi connect plants below ground via hyphal networks and influence the movement of resources in plants which also influence plant productivity and plant

diversity, abundant as those creatures are, little is known about their contribution to the soil carbon sequestration. Our project aims to model the impact of mycorrhizas on soil carbon sequestration by modifying the current soil sequestration model YASSO (with corporation of FMI in Helsinki), to understand the role of mycorrhiza in global soil carbon sequestration and to predict the results of future climate change and land use change. This project therefore will include lab experiments of mycorrhiza cultivation, database management and model simulation by computer programming (Python mainly) and land use change scenario running with the combination of GIS analysis methods. Any BSc or MSc students interested in the projects are welcome.

Supervisors: MSc. Weilin Huang, w.huang@cml.leidenuniv.nl, tel. 2215.
Dr. Nadia Soudzilovskaia, n.a.soudzilovskaia@cml.leidenuniv.nl, tel. 7485.

Period: Starting from February

Multiple projects on impacts of mycorrhizas on ecosystem functioning



Mycorrhiza is a symbiotic relationship between plant and fungi, in which plant provides fungi with carbon, and fungi supplies nutrients and water to plant, extracting it from decomposing plant litter. While it is widely recognized that mycorrhizal presence abundant and types strongly affect carbon and nutrient flows in ecosystems, aboveground community composition and above-belowground interactions the mechanisms of these impacts are still poorly understood. Multiple research projects aiming to unravel these mechanisms are available.

Those include, but are not limited to:

- analyses of drivers of geographical distribution of mycorrhizal plants and fungi
- impacts of mycorrhizas on ecosystem functioning
- analyses of the nature of interactions between microbial, mycorrhizal fungal and plant communities

Experimental and modelling projects possible. Some projects include travelling abroad for field or lab work (China, Finland, Sweden, Russia)

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

Period: No specific requirements; It depends on the project

Influence of soil properties on the toxicity of TiO_2 nanoparticles on soil bacterial community

Titanium dioxide nanoparticles (TiO_2NPs) are increasingly released in agricultural soils through, e.g. biosolids, irrigation or nano-agrochemicals. The increasing environmental release of TiO_2NPs raises concerns about the potential effect on soil microbial functioning and consequently on its capacity to fulfill essential ecosystem services. Soils are porous systems consisting in complex structured assemblies of mineral and organic particles combined with liquid and gaseous phases. Soil properties such as clay and organic matter (OM) contents or pH greatly influence the behavior and bioavailability of common pollutants like NPs. However, little information is available on the influence of soil properties on the characterizations of TiO_2NPs, which will determine their effect on soil microbial community.

Our previous study found that TiO_2NPs altered the composition and functional profile of soil microbial community. However, these pioneer studies were performed with a single model soil.

Since extrapolation of results from one contaminated soil to another is difficult because of the great heterogeneity of soils, the aims of this project are to 1) characterize TiO_2NP properties in different soil types; 2) investigate effect of soil properties on the TiO_2NP toxicity on soil bacterial community. Four types of soils have been collected with different OM contents and texture. The student will be introduced into soil microcosms exposure and TiO_2NPs characterizations, and will learn as cutting-edge molecular biology techniques as well as bioinformatics. The analysis of the data requires comprehensive thinking, connecting effects at taxonomic level with observed adverse effects at community functioning 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: Yujia Zhai, MSc: tel. 1476, email: y.zhai@cml.leidenuniv.nl
Prof. dr. Martina Vijver: vijver@cml.leidenuniv.nl
Prof. dr. Willie Peijnenburg: willie.peijnenburg@rivm.nl

Effects of spatial scale on the fidelity of the cetacean stranding record in the Caribbean. MSc Internship.

Cetaceans play an important role in the structure and function of marine ecosystems. As top predators, cetaceans are highly vulnerable to numerous human activities, of which fisheries are the most important. As a consequence, the conservation status of many species of cetaceans is of great concern. Inadequate information on their distribution is a major source of uncertainty, particularly in tropical regions. For conservation management to be effective, knowledge of cetacean ecology and distribution is needed. However, this requires data that are expensive and time consuming to obtain. Pyenson (2011) suggested that stranding records may provide a better basis for characterizing the cetacean species in an area than sighting data, provided that sampling extends across large latitudinal gradients (2000 km) and for periods longer than 10 years. However, this is based on Great Britain where they have systematically recorded cetacean strandings since 1913. The question remains if this is the case in general (worldwide) or only for areas that have a solid stranding network. If stranding records provide a more accurate knowledge on cetacean diversity than sighting data in less well-known areas (e.g. Caribbean), then the question remains on what spatial scale(s) (entire Caribbean vs individual islands). Is there a difference in stranding fidelity between species or habitats (e.g. large vs. small species, coastal vs. deep-sea)?

To answer these questions a database with all the sighting and stranding data in the Caribbean is needed. The database will be set-up in collaboration with Caribbean partners. This is a desktop study. The student should have an interest in cetacean management and conservation, the ability to find obscure publications and grey literature and be motivated to publish the results.

Supervisor: Dr. Jolanda Luksenburg, j.a.luksenburg@cml.leidenuniv.nl, tel 7285
Prof.dr.ir. Peter van bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel 7486.

Impacts of climate change and light pollution on plant phenology and communities

When was the last time you saw the Milky Way? Extensive use of artificial light at night has resulted in 83% of the world's population living under light-polluted skies, with effects for human health and alteration of behaviour of many animal species. The effect of light pollution on plants however, has hardly been studied. Plants sense day length (photoperiod), and use this information, in combination with other cues such as temperature, to time phases like budburst (spring), flowering and leaf fall (phenology). Since artificial light at night can increase perceived day length, it may affect the phenology and fitness of plants. Importantly, the effects of climatic warming, which tend to advance the phenology of many plant species, may be amplified or cancelled out when interacting with light pollution. The timing of plant phenological events in turn affects insect and other communities, so I aim to better understand the extent and relative importance of these human-induced changes.

I currently have a number of projects (with various options for – a combination of – desk, field, lab studies) that aim to unravel the effects of light pollution and/or climate change on plant phenology and cascading community effects:

1) Effects of light pollution of different colours (see image below) on plant phenology and traits and on insect communities in a large-scale field experiment at several sites on the Veluwe (central Netherlands) – drivers' license and own vehicle required.

2) Field measurements on the effect of light pollution and urban heat island on the timing of leafburst on urban and peri-urban trees.

3) Laboratory experiments to investigate the effect of artificial light on the oviposition and feeding behaviour and fitness of moths, and/or the budburst and traits of plant species.

4) Assessing the timing of leafburst and leaf-fall of different tree species, in relation to the amount of light pollution they experience, using image analysis of existing long-term data recorded by webcams (private and e.g. traffic control footage).

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

Monitoring of biodiversity effects on Drought resilience/resistance

It has been well established that a high level of biodiversity increases the resilience of ecosystems to 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. Already it has been shown a high diversity of grass species provides positive resistance to natural (ecological) disasters such as droughts (1). During this research we would like to investigate if this is also true for functional diversity. This will investigate field measurements in Panama as well as some satellite monitoring.

This project is open for a BSc or MSc student.

Supervisors: Dr.ir. Joris Timmermans, j.timmermans@cml.leidenuniv.nl, tel. 2727.
Dr. Rosaleen March: r.g.march@cml.leidenuniv.nl, Tel: 5615
Msc Qi Chen: nmchenqi@hotmail.com

Understanding the response of functional biodiversity to large-scale disturbance

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. Viewing communities as a collection of traits rather than species, allows ecologists to more closely link biodiversity with ecosystem functions.
Mapping FD on a landscape scale over time can help us understand how diversity as well as specific traits respond to disturbance such as drought. We can determine the drivers of change, such as species, climate, and soil variables. This can also help us understand fundamental questions related to ecological succession and climate change. Barro Colorado Island in Panama is an extensively studied Smithsonian research Station with well-documented individuals and communities since 1981 and since then has suffered multiple drought events. Drought studies there have mixed conclusions as to the community shifts that have resulted. Therefore, examining a suite of functional traits as well as functional and species diversity will give some insight into how diverse tropical systems are responding to drought events, which are expected to increase. Additional topics related to this study are open to discussion. This project is open for a BSc or MSc student.

Supervisors: Dr. Rosaleen March, r.g.march@cml.leidenuniv.nl, 7497
Dr.ir. Joris Timmermans, j.timmermans@cml.leidenuniv.nl, tel 2727
MSc. Leon Hauser, l.t.hauser@cml.leidenuniv.nl, tel 5649
Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, 7486

Identifying global and local trends from long term Climate Data Records

Many Essential Climate Variables (ECVs) are 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

Understanding temporal variability in functional biodiversity

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. Viewing communities as a collection of traits rather than species, allows ecologists to more closely link biodiversity with ecosystem functions. 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. In this project we will try to increase this understanding by analyzing trends in the acquired data from sites in Finland, the Netherlands and Ghana. Projects can focus on temporal dynamics of functional diversity, retrieval of traits through remote sensing, or other ideas in consultation with the supervisor. This project is open for a BSc or MSc student.

Supervisors: Dr. Rosaleen March, r.g.march@cml.leidenuniv.nl, 7497
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

Investigating the impact of climate and varying growth forms on phenological plant functioning

Plant traits are used to describe ecosystems in their functioning, which helps us relate it to both the environment such as climate change, as well as things like biodiversity and plant health/drought. Plant traits are also useful because they can help us to better understand an ecosystems response to things like changes in climate over the growing season.
In this project you will investigate if plant traits have synchronized responses phenologically (throughout the growing season) in response to changes in climate and in relation to different plant growth forms. Data is available from several field sites, including the Netherlands, Finland and Ghana. Other sites such as Germany are available with lab work included. Leaf traits include chlorophyll, carotenoids, phenols, anthocyanins, Carbon/Nitrogen, Lignin, and Non-structural Carbons (Celllulose, Startch, etc.).

Supervisors: MSc Amie Corbin, a.e.corbin@cml.leidenuniv.nl
Dr.ir. Joris Timmermans j.timmermans@cml.leidenuniv.nl, tel 2727.
Dr. Nadia Soudzilovskaia n.soudzilovskaia@cml.leidenuniv.nl

Evaluation of traits retrieval in (evergreen/tropical) 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, and Kogyae, Ghana. 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

Lake/Land evolution in the Marker Meer

Recently, several islands have been erected in the Markermeer (the Netherlands). By removing the toplayer of lake-soil (which negatively impacts the foodchain of algaue, fish and birds) this can be used to grow the Markermeer islands. In this case the natural balance will be restored, while also providing a new nature reserve for birds. This provides a unique experiment for scientists to investigate the creation of a new ecosystem of a large scale, specifically on the evolution of pioneer vegetation/animals, evolution of landscape from empty land to swamp and the increase of biodiversity in the lake and on the islands. This research will involve fieldwork in the Markermeer and the Markerwadden (only reachable by sailing boat). This project is open for a BSc or MSc student.

Supervisors: Msc. Nuno César de Sá; n.q.cesar.sa@cml.leidenuniv.nl
Dr.ir. Joris Timmermans, j.timmermans@cml.leidenuniv.nl, tel. 2727

Water quality Monitoring

Most, if not all, living organism depend on Water to survive which makes monitoring its quality of the most important challenges on the coming years. As not all humans have good access to good quality water, so do not all organisms. In a country like the Netherlands while the human population obviously enjoys a full access to excellent water, the other fauna and flora only has access to whatever is available in the canals, dykes, lakes and ponds. Water can greatly vary in quality due to agriculture, sewages, etc which in turn can have very big impacts on the ecosystems.
While there are numerous tools to measure water quality they are only able to measure one specific location at a time and they can easily become very expensive. Water Quality monitoring using drones or satellite Remote Sensing (RS) is an emergent research field due to the increasing amount of sensors both in number and quality that are becoming available. While it has already been shown that RS offers

the possibility of monitoring some of the more common water quality parameters it is important to explore the new opportunities offered by the new satellite constellations (e.g Copernicus mission, Planetlabs). The student will explore the ability to to monitor water quality with these instruments as well as linking that knowledge to impacts at an ecological level on fauna and flora. This research will include fieldwork in the Netherlands (most probably in the Meijendel Dunes, Markermeer and Waddenzee as well some smaller locations). This project is open for a BSc or MSc student.

Supervisors: Msc. Nuno César de Sá; n.q.cesar.sa@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, tel. 7486

Effects of saline water on plant growth and processes

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.

There is however still a lot of unknown, as this facility does not study the changes within the actual plants (such as the changes in photosynthesis and evaporation). By looking at leaf traits of different plant species during the growth stage such effects can be monitored. This research includes fieldwork in Texel, the Netherlands during May-Jul. This project is open for a BSc or MSc student.

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

Monitoring invasive plant species in the Oostvaardersplassen

As one of the most significant examples of Rewilding conservation, the Oostvaardersplassen faces increasing challenges from the Dutch citizens regarding the quality of life for its inhabitants. If that wasn't enough, the expansion of *Jacobaea vulgaris*, a toxic plant is also potentially contributing to a reduction of the food availability for the large mammals. The interest on this species is double since while it is a native species in the country, it is potentially showing an invasive behavior within the park. Monitoring the expansion of this "exotic" species is crucial to provide the Staatsbosbeheer with the tools to curb its negative impacts on the animal population. This research will focus on investigating the detectability of this species by drones or satellite observations. This research will therefore focus on fieldwork is required. This project is open for a BSc or MSc student.

Supervisors: Msc. Nuno César de Sá; n.q.cesar.sa@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, tel. 7486

Drivers of urban fauna and flora distributions

As urban areas expand, new species assemblages develop as an adaptation to the changing environment. Not only Green areas contribute to biodiversity but potentially every new aspect of a city can, or not, contribute to the establishment of new species. Tools such as Ecological Niche models are allow the prediction of species distribution based simply on occurrence and environmental factors (distance to roads, climate, etc). Futhermore, overlaying the maps these models produce allows identifying biodiversity hotspots. The student will work in the region of Den hague with data from the National Database of flora and fauna, produced by collaborative work from citizens and governmental bodies, with optional fieldwork to enrich the database when necessary.

This project is open for a BSc or MSc student.

Supervisors: Msc. Nuno César de Sá; n.q.cesar.sa@cml.leidenuniv.nl
Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel. 7486

Improving soil ecosystem functioning through the impact of organic waste on soil microbial communities

Soils host thousands of different micro-organisms and are therefore considered among the most complex and diverse ecosystems on the planet. Maintaining these ecosystems is important to mankind as they have important functions that influence agricultural productivity, regional water balances, and even our fight against climate change (by storing carbon). By applying organic waste to land we can stimulate soil microbes, possibly enhancing many of these soil functions. Despite this, much of the organic waste we produce is never returned to land. In this project you will investigate for a selection of organic wastes of your choosing (for example: mown grasses, forest litter, municipal waste, etc), the impact they have on the soil microbial community and the potential they offer in terms of improving one or multiple of the aforementioned soil functions. The project will involve a laboratory soil incubation- and/or field experiments, and offers the opportunity for fieldwork and stakeholder involvement.This project is open for a BSc or MSc student.

Supervisors: Dirk-Jan Kok, d.d.kok@cml.leidenuniv.nl
Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel. 7486

Forest canopy from laserscanning

Leaf angle distributions (functions) (LIDF) are of vital importance for the ecological functioning of a forest. Hence, information on this property is critical in forest applications. However, measuring leaf angles in forests are very time-consuming. In this view, laserscanning might provide a tool to greatly speed-up this effort. A Laserscan 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 will be measuring how a TLS system can be used for this purpose. The fieldwork will focus on different forested area's in the Netherlands, Ghana and Panama. This project is open for a BSc or MSc student.

Supervisors: Dr.ir. Joris Timmermans, j.timmermans@cml.leidenuniv.nl, tel. 2727.
Dr. Rosaleen March: r.g.march@cml.leidenuniv.nl, Tel: 5615
MSc. Amie Corbin: a.e.corbin@cml.leidenuniv.nl

Developing new tools for visualizing biodiversity of the Hague

The municipality of The Hague is looking for a student that can validate, improve and extend the used method to display biodiversity on a map. Main goal is to develop a scientific funded method to express biodiversity data of The municipality of The Hague based on the National Database Flora and Fauna. The student will have to address the challenges of data missingness, accuracy and develop a tool or framework to visualize biodiversity which can be used in the decision making process of the municipality of The Hague. This project is open for a BSc or MSc student.

Supervisors: MSc. Nuno César de Sá; n.q.cesar.sa@cml.leidenuniv.nl
Prof.dr.ir. Peter van Bodegom, p.m.van.bodegom@cml.leidenuniv.nl, tel. 7486
Dr. Mitra Baratchi, m.baratchi@liacs.leidenuniv.nl

Technical modification of Spectrometer system

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. For this field spectrometer measurements are required at high frequency. The problem however is that at the moment our spectrometer setup does not allow unsupervised measurements. Within this technical project, we will investigate how to modify the spectrometer to enable this. In particular we will investigate of how to

properly enable reference and target spectral measurements. As such measurements cannot be performed when it's raining, rain sensors need to be integrated within the controlling mechanisms. This project is available for both an MSc HBO student.

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
Msc. Amie Corbin: a.e.corbin@cml.leidenuniv.nl

Automation and correction of field spectrometer data for RTM retrievals

Field spectrometer collection is one part of remote sensing data which often comes with its own set of errors. reflection data is collected on site at ground level (or above canopy level) based on a white reference plate. However, this data can often be noisy, and subject to error due to atmospheric or environmental surroundings and often requires some degree of correction, smoothing or even removal. Data has been collected from several sites (Ghana, Finland, Netherlands, etc.) over two years throughout the entire growing season over the 350-2500nm spectral range.

This project involves 1) Setting up a protocol suitable to different site enviornments (tropical vs. Temperate) 2)Error flagging and correction, 3) protocol for smoothing (or lack there of) 4) Automation of code for current and future use of spectrometer data.

This project is available for both an MSc and HBO student (available to outside departments). Strong skills in coding and informatics are preferred.

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

Measuring aerosols with milk cartons

Aerosols, small particles floating in the air, have a significant impact on our health and environment, yet very little is known about them. Aerosols come in all shapes and sizes, and from many sources: car exhausts, flower pollen, soot from barbecues, and many more. Many satellites and ground-based sensors are devoted to measuring the amount of aerosols in the atmosphere. These provide great data but are often extremely expensive, and may have poor coverage over time and space. Since aerosols affect each of us, ideally we would want each of us to measure them for ourselves. In this project we want to answer the question: Can we use milk cartons as a cheap and simple method to measure aerosols? We want to develop a method for measuring aerosols that involves simply cutting a piece of white cardboard from a milk carton, putting some vaseline on it, and sticking it on your outside wall. The aerosols then naturally stick to the cardboard, and it will slowly become darker. This change in colour can be measured with a technique like smartphone photography. Within this project we want to develop the milk carton method and test its accuracy. This will also require building a robust calibration method for smartphone colour measurements. The project will involve mostly lab work and field work, with some software development mixed in.

Supervisor: MSc. Olivier Burggraaff, burggraaff@strw.leidenuniv.nl
Dr.ir. Joris Timmermans, j.timmermans@cml.leidenuniv.nl, tel. 2727.

What's in the diet? Genetic assessment of lion diet and its relation to nature management strategies.

The ecological functioning of large carnivores is evidently linked to numerous direct and indirect economic and ecosystem services (even climate change), and thereby inevitably connected to human welfare and happiness. However, African large carnivores are under increasing pressure and face dramatic population declines. To conserve the large predators in Africa it is suggested that in the near future only fenced protected intensively managed areas may save predator populations. However, conservation success of management practices is dependent upon many different factors which all may contribute to or counteract the success of conservation efforts. This makes current management

strategies suboptimal and evaluating them difficult. This research aims to use diet analysis to study the effectiveness of management for large carnivore conservation. Therefore, we will study diets of lion populations originating in different National Parks (NPs) where different types of management are applied. Furthermore, in contrast to traditional diet studies, we additionally propose to use DNA- based techniques that can potentially provide more accurate dietary resolutions. Hence, a better assessment of the large carnivore dietary ranges and components. Ultimately, we aim to increase the understanding of the relationship between management and lion diet to improve the conservation of large carnivores.

To gather enough data to answer this research question tough extensive fieldwork is needed. Therefore, we are looking for MSc students (preferably pairs) who are willing to spend approximately 3 months in a National Park in Kenya mostly focusing on lion prey counts (transects), hair morphology analysis, lion tracking and gathering scat samples. Fieldwork is from 11th of February 2019 until 5th of May in Meru NP, Nairobi NP, Nakuru NP and Amboseli NP. After field work you can either continue with DNA analyses, depending on the length of internship or use the hair morphology + transect counts data collected in the field to investigate the diet of lions in each park. Internships will start in January 2019.

Important is that students are also cooperating with the PhD projects of Monica Chege (Nakuru NP) and Luka Narisha (Meru NP), who can have additional research questions available. So research is certainly not limited to diet analyses.

Supervisors: Dr. Krijn Trimbos, trimbos@cml.leidenuniv.nl, tel. 7457
Kevin Groen, MSc., k.groen@cml.leidenuniv.nl, tel. 6822
Monica Chege, MSc., m.m.chege@umail.leidenuniv.nl, tel. 2727
Luka Narisha, MSc., l.l.narisha@cml.leidenuniv.nl, tel. 5615
Advisor: Prof. Hans de Iongh

Monitoring flora and vegetation of nature-friendly ditch banks in the Bollenstreek (HLT) and Leiden region

A number of municipalities in the Bollenstreek (HLT: Hillegom, Lisse, Teylingen) and Leiden region realized a number of nature friendly ditch banks (NVO). The NVO not only have a role in enlarging biodiversity in urban and rural areas, but are also an instrument for climate change adaptation, especially the collecting of precipitation surplus. Some of the NVO are recently realized, but others are already present for a longer period of 5-10 years. Goal of the research is to investigate the state and development in time (older information is available) of all NVO in the nearby regions, by using vegetation relevées, and also the testing the practicability of a citizen science (CS) protocol specially developed for the flora of ditch banks. Preferably a Master student, because research takes place during flowering season (May-July)

Supervision: Wil Tamis (CML), tamis@cml.leidenuniv.nl
Marco Roos (Naturalis), marco.roos@naturalis.nl
Duration: 4-6 months

Multiple projects available within the TERRA-Dunes research platform.

Within the TERRA-Dunes research platform we aim to understand how soil organisms control on functioning of dune ecosystems and to provide practical solutions for targeted restoration of dune ecosystems. This project is run together by CML and IBL institutes. Dunes represent a mosaic of ecosystems at distinct successional stages: sand dunes, grasslands, and ultimately forest. This mosaic of landscapes allows high biodiversity to sustain and makes dunes attractive for visitors.


In our research we examine how soil chemical and mechanical properties and soil microbial community impact structure and composition of the aboveground plant and animal communities. We introduce different soil communities in the same, previously degraded, dune area and expect that the directions of ecosystem development in these degraded soils will be dependent on the type of soil microorganism additions. While our research has a fundamental scientific character, outcomes will provide important practical solutions for the use of soil in ecosystem restoration and will support dune managers to efficiently protect biodiversity of organisms and landscapes.

Supervisors: Mr. Chenguang Gao, n.a.soudzilovskaia@cml.leidenuniv.nl, tel. 7485.
Dr. Nadia Soudzilovskaia, n.a.soudzilovskaia@cml.leidenuniv.nl, tel. 7485.
Prof. Martijn Bezemer, t.m.bezemer@biology.leidenuniv.nl

Biodiversity and Ecosystem Services

Nature's contributions to people in urban areas

More and more people in The Netherlands are living in urban areas. With the economy booming again, new houses are being built and neighbourhoods are (re)constructed. At the same time, people are increasingly disconnected from nature; access to urban green space or water is not as common as one might think. Many municipalities and other stakeholders are recognizing this and have become interested in themes like nature-inclusive urban planning, green infrastructure, sustainable living, circular economy etc.

The concept and framework of ecosystem services connects ecosystems and biodiversity to human wellbeing and can be used to assist in studying the links between nature and people in urban areas. Examples of urban ecosystem services include local climate regulation, water flow regulation, air quality regulation, and cultural services like recreation and sense of place.

Together with stakeholders from municipalities of Leiden, The Hague and / or Delft, internship students will provide quantitative analyses of urban ecosystem services, for instance through GIS analysis, integrated valuation approaches, participatory research and on-site fieldwork. Please note, however, that fieldwork cannot always be guaranteed, desktop study can also be an option. Moreover, the availability of internship opportunities depends on whether there are concrete questions from our contacts at the different municipalities. If applicable, the internship will be carried out in collaboration with students and researchers from the Leiden-Delft-Erasmus network.

Students should have a genuine interest in interdisciplinary research, stakeholder engagement 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. Peter van Bodegom; p.m.van.bodegom@cml.leidenuniv.nl tel 7486.

Biodiversity of epiphytes and ecosystem services

Epiphytic plants are obscure and hardly understudied group of plants. However, in the rain forest those plants are highly abundant and are likely to be important for ecosystem functioning as well as significantly contribute to the image of rain forest and the set of products and services in a broad sense obtained by people from the these forests. In this project you will examine how epiphytic plants contribute to the set of ecosystem services provided by rainforests. The project runs on an interface of ecological and sociological research. It will be conducted in collaboration with Naturalis Biodiversity Center, and is likely to encompass travelling to Brazil (Atlantic forest) for field work.

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

Ecosystem management to optimize ecosystem services.

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 for society. 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, and global-scale studies. Case studies will always be conducted in dialogue with end-users, i.e. stakeholders that have direct interest in the produced knowledge. Examples include: municipalities, Rijkswaterstaat, water boards, consultancies and international science-policy initiatives.

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.

Students should have a genuine interest in interdisciplinary research, stakeholder engagement 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. Peter van Bodegom; email p.m.van.bodegom@cml.leidenuniv.nl tel 7486.