University of Antwerp
Evolutionary Ecology Group

# MP and IP subjects

https://www.uantwerpen.be/en/research-groups/eveco/education/masterproject-and-ipsubjects/

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# Who are we?

University of Antwerp
Evolutionary Ecology Group

- Five large research themes
  - Ecology of infections and host-parasite interactions
  - Spatial ecology
  - Ecological and evolutionary responses to global change
  - Morphological expressions of stress, fitness and quality
  - Understanding evolution using genomics
  - Applied population biology: conservation, pests, invasive species

5 professors, 2 guest professors:

museum

RESEARCH INSTITUTE NATURE AND FOREST

ZOO SCIENCE


Hannes Svardal


Herwig Leirs


Erik Matthysen


Stefan Van Dongen


Sophie Gryseels


Erik Verheyen


Luc De Bruyn


Philippe Helsen

https://www.uantwerpen.be/en/research-groups/eveco/

# General information

- Listed topics are broad
- Final subjects decided after discussion with the student
- Suggestions for other topics are welcome!
- Open for all Master of Biology students, regardless of their orientation.
- Many topics possible for Master thesis as well as Individual project
- Applied methods vary widely between subjects, e.g.
  - Field work with live trapping of rodents, bats, birds, fishes
  - Statistical analysis of own or existing data (CMR, GIS, ...)
  - Mathematical modelling
  - Molecular genetics, DNA barcoding, immunology
  - Genomics, hybridization
  - Virus phylogenetics and epidemiological modelling
  - ...

# Evolutionary ecology of mammals (and pigeons) and pathogens


Prof. dr. Herwig Leirs herwig.leirs@uantwerpen.be
Prof. dr. Sophie Gryseels sophie.gryseels@uantwerpen.be
Prof. dr. Joachim Mariën joachim.marien@uantwerpen.be
Dr. Bram Vandenbroecke lea.joffrin@uantwerpen.be
Dr. Léa Joffrin bram.vandenbroecke@uantwerpen.be
Anna Piscitelli annapia.piscitelli@uantwerpen.be
and others


Frequent collaborations:

INSTITUUT NATUUR- EN BOSONDERZOEK

museum Royal Belgian Institute of Natural Sciences

UNIVERSITE DE KISANGANI

SOKOINE UNIVERSITY OF AGRICULTURE '1984' ARDHI NI HAZINA

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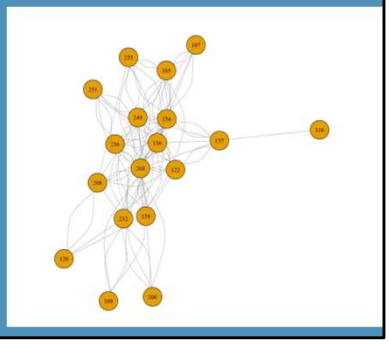
## Movements and pathogens of rats and mice in Flanders

- **Correlating infection state with movement and sociality** — **MP**
- **Effect of rodenticides on movements** — **MP**
- **Infection (virus, bacteria) prevalence in rats in Flanders** — **MP/IP**

Contact: Bram Vandenbroecke, Sophie Gryseels



Brown rats pose significant challenges in agriculture due to their role in causing extensive damage to infrastructure and food storage, posing potential risks to livestock health by serving as hosts for a wide array of diseases.

EX1: Comprehensive data on the movement and social interactions of rodents, along with blood samples, have been collected at a fine-scale resolution. The student will analyze the blood samples to detect pathogens and establish connections with the rodents' movement and social behavior.

EX2: INBO has initiated a project aimed at assessing the impact of a new rodenticide on rodent movement within farms in Flanders.

EX3: Across Flanders, we've gathered 1200 frozen rats through trapping efforts. The student will conduct dissections and assess the presence and distribution of specific diseases throughout the Flanders region.

CONTACT:
Bram Vanden Broecke, Bram.VandenBroecke@uantwerpen.be
Prof. Dr. Herwig Leirs, Herwig.leirs@uantwerpen.be

## Personality and Infection in the Multimammate mice

- **Individual differences in scent marking** MP
- **Stress and personality** MP
- **Differences in cognition?** MP
- **Personality and dispersion** MP
- **Personality and defence strategies against parasite infections** MP

Contact: Anna Piscitelli

All fieldwork is Summer 2024

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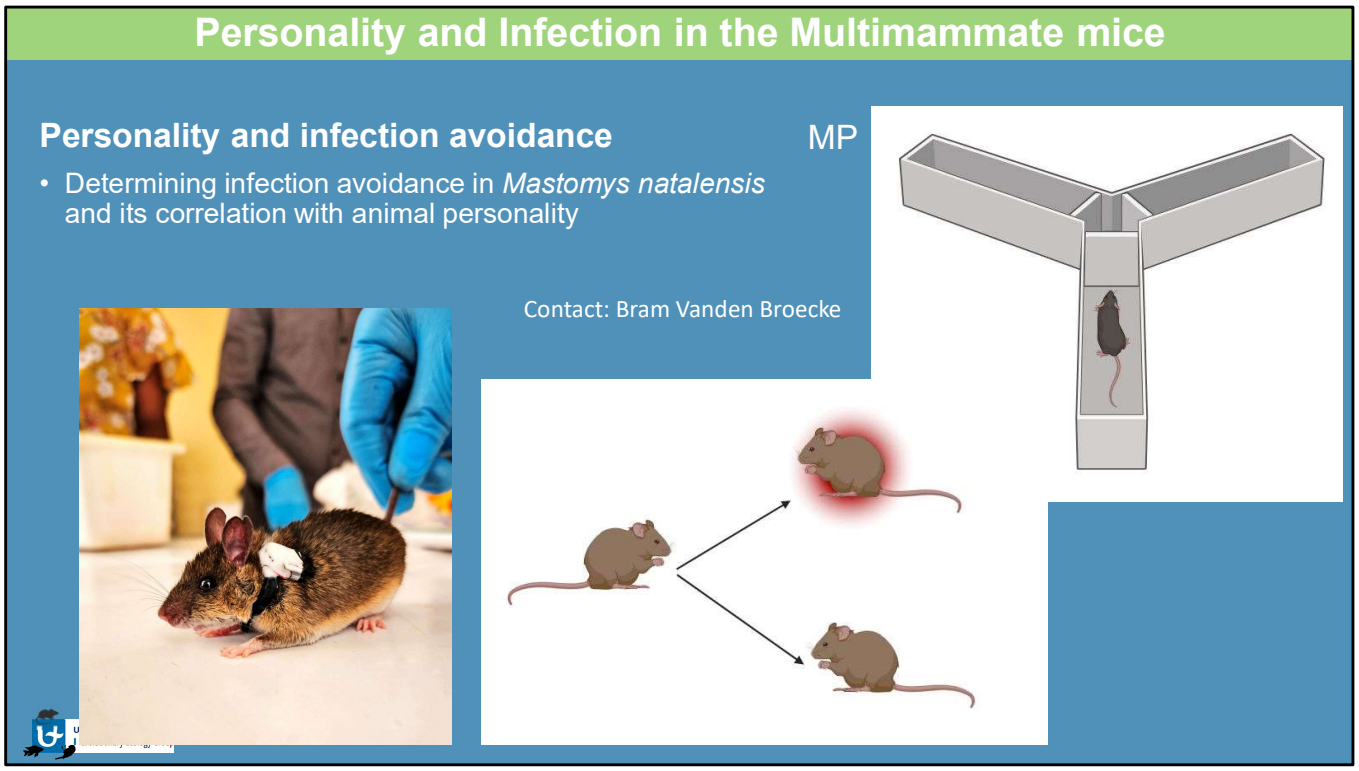
Animal personality is the phenomenon that within a population, individuals consistently differ from each other in their behaviour. This means that some individuals are always more (or less) aggressive (or explorative) than others. They do not only differ in their behaviour, but also in fitness, immunological invest, metabolism, parasite susceptibility, and even cognition.

Nevertheless, relatively little is known about the evolutionary and ecological implications of personality. Using the multimammate mice as a model system, we want to know if there are potential fitness costs of certain personality types (like increased parasitism) and if they can smell each other. Additionally, this species is an important pest species as well. How efficient are certain trap methods and does personality affect this?
The fieldwork for this project (in Tanzania) is planned for next Summer.

Contact:
Bram Vanden Broecke, Bram.VandenBroecke@uantwerpen.be
Anna Pia Piscitelli
Prof. dr. Herwig Leirs, Herwig.leirs@uantwerpen.be




Animal personality is the phenomenon that within a population, individuals consistently differ from each other in their behaviour. This means that some individuals are always more (or less) aggressive (or explorative) than others. According to the risk-of-parasitism hypothesis, more explorative (or aggressive) individuals have a higher probability to become infected (i.e. show less avoidance). Nevertheless, the consequences of personality differences on infections avoidance have rarely been investigated.

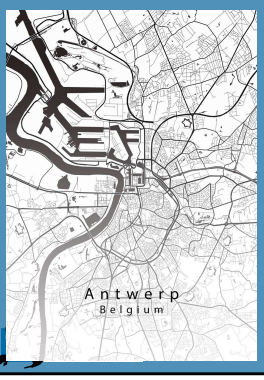
There are two main sources affecting risk of infection: the first and potentially the greatest, is contact with conspecifics who are likely to harbour the parasites, the second source is the objects and environments that might harbour parasites or their infective stages. Within this project we will investigate risk avoidance with these two sources using lipopolysaccharide (LPS) to mimic a parasite infection.

The experiments will take place at the University of Antwerp

Contact:
Anna Pia Piscitelli, AnnaPia.Piscitelli@uantwerpen.be
Bram Vanden Broecke
Prof. dr. Herwig Leirs, Herwig.leirs@uantwerpen.be

## Diseases in feral pigeons

- **Spatio-temporal variation in disease prevalence in urban environments** **MP/IP**
  - Detecting and mapping diseases in feral pigeons in Antwerp
- **Personality and sociality in feral pigeons** **MP**
  - Determing social behaviour, dominance and personality in feral pigeons
- **Immunity and environmental pollution** **MP**
  - Determine the link between immunity and pollution and the potential for pigeons to serve as bioindicators for heavy metal pollution





Contact: Bram Vanden Broecke

"*Infection dynamics in the Anthropocene - tracking super spreaders and infection hotspots in the urban jungle*" project aims to **investigates which factors drive disease dynamics at the population-level in wild animals living in urban environments**. More specifically, it focuses on the spatio-temporal clustering of disease transmission using feral pigeons and the parasitic bacterium *Chlamydophila psittaci* as a model system.

EXP1: We are collaborating with the city of Antwerp who are actively controlling pigeons in the city of Antwerp. They can provide us with huge quantities of samples which need to be analysed. This information will give us a more detailed of the spatio-temporal variation in disease presence in the city of Antwerp

EXP2: Animal personality has a large effect on the transmission of diseases. In this study, we want to investigate the flocking behaviour of pigeons. More specifically, we will look at social behaviours, personality and dominance and link this with disease presence

EXP3: Heavy metal pollution has an immunotoxic effect. In this study, we want to investigate this in the feral pigeons and their potential to serve as a bio-monitor for heavy metal pollution

CONTACT:
Bram Vanden Broecke, Bram.VandenBroecke@uantwerpen.be

## How does formalin fixation influence DNA/RNA quality in archived mammals (Mare Geraerts)

### MP/IP

Contact: Sophie Gryseels

- How has formalin fixation affected the fragment length of DNA/RNA in archived specimens?
- Is the length of DNA/RNA fragments correlated to the age of samples? Are fragments shorter in older samples?

**IN PRACTICE**

- Tissue sampling of museum specimens at the Royal Museum for Central Africa (RMCA) and Royal Belgian Institute of Natural Sciences (RBINS)
- Focus on wild mammals from central Africa collected over the last century
- DNA and RNA extraction
- Sample quality control of biomolecules using a Bioanalyzer

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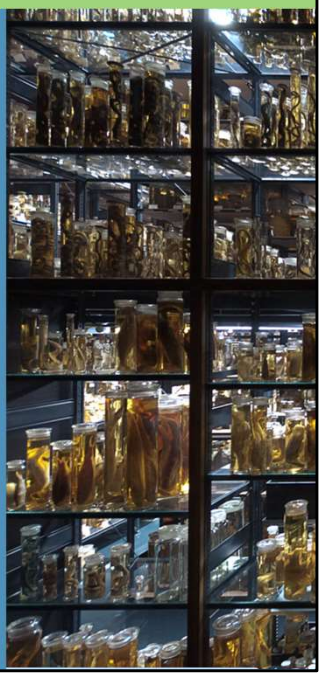
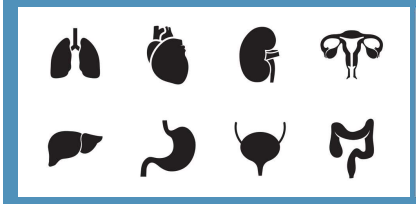
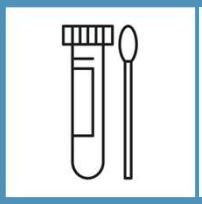


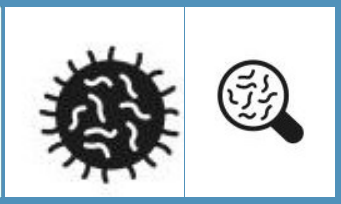
# Viral tropism – which organs host which viruses

Contact: Sophie Gryseels

- **Virus prevalence in different organs** **MP**
  - Detecting Coronaviruses in lung/colon samples of positive individuals (positive swabs)
  - Screening different organs of individuals that tested positive for Paramyxo-/Hepaciviruses in kidney/liver
- **Virus detection in non-invasive vs invasive samples** **MP**
  - Testing for viruses in oral swabs and tongue/nose samples of same individuals
  - Testing for viruses in rectal swabs and colon samples of same individuals







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# Reconstructing disease dynamics in Africa using historical museum collections and archives

Contact: Sophie Gryseels

MP

- History of Tilapia lake virus in central Africa
  - Optimize detection assay for Tilapia lake virus in museum specimens
  - Trace back start of tilapia lake virus pandemic in wild and cultivated tilapia by screening museum specimens

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museum
Royal Belgian Institute of Natural Sciences

# eDNA, biodiversity and bloodmeals

Contact: Sophie Gryseels

IP

- Estimating local biodiversity from carrion fly bloodmeals
  - Using existing sample set of carrion flies from tropical forest in DR Congo
  - Molecular laboratory experiments to determine diversity in bloodmeals

MP

- Estimating arbovirus spillovers by analysing mosquito bloodmeals along an urban-rural gradient in Tanzania
  - Fieldwork catching mosquitoes in Morogoro, Tanzania
  - Molecular laboratory experiments to determine diversity in bloodmeals
  - Do mosquitoes feed on both humans and rodents?

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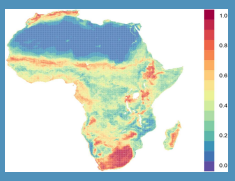
## Reconstructing disease dynamics in Africa using historical museum collections and archives

Contact: Joachim Mariën

- What is the impact of global change on the distribution of vector-borne and zoonotic diseases? MP
  - Archival work
    - Pathogen screening
    - Archives
    - Literature
  - Data analyses
    - Statistical models (GLMs, GAMs)
    - Mathematical models (SIR)
    - HMSC models
    - Environmental niche models

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In this thesis you will investigate the impact of global change on the distribution of vector-borne and zoonotic diseases by combining historical and present-day information about climate, biodiversity, land cover, land use, human demography and behavior with information on disease spread. You will collect data in the historical archives at the Africa museum in Tervuren (Brussels) and complement it with a literature search. All data will be combined to analyze how disease dynamics changes over the years in central Africa. You can focus on several different diseases, including bubonic plague, schistosomiasis, sleeping sickness, arboviruses, monkeypox or ebola virus or malaria.

Contact: dr. Joachim Mariën; Joachim.marien@uantwerpen.be;

## Eco-epidemiology of rodent-borne pathogens

Contact: Joachim Mariën

- How do pathogens spread and persist in rodent communities? MP
  - Field work in Tanzania
  - Lab work
    - Pathogen screening (viruses, bacteria)
      - PCR & sequencing
    - Serology
      - multiplex assays (Luminex) & IFA
  - Data analyses
    - Statistical models (GLMs, GAMs)
    - Mathematical models (SIR)
    - HMSC models


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Although most emerging infectious diseases are caused by animal-borne pathogens that originate from wildlife, the ecological mechanisms that explain how these pathogens spread and persist in the natural environment remain unclear. This research gap arises from the practical challenges of gathering convincing field data due to the stochastic nature of epidemics and the fact that these are longterm, population-level processes. In this project you will investigate how differences in rodent communities and densities influence the prevalence, persistence and control of pathogens that infect multiple host species. These mechanisms lie at the root of an ongoing debate in conservation biology: whether biodiversity loss will lead to an increase or decrease of infectious disease that might spillover from animals to humans. The work will be based on the analysis of a unique collection of rodent samples that were captured during fieldwork performed in Tanzania and the DRCongo and will be tested on the presence of different pathogens (e.g. Bartonella, Anaplasma, arenaviruses, paramyxovirus, coronavirus, orthopoxvirus). By combining this data collection with additional field experiments and mathematical models, your will test three main hypotheses: (i) pathogens tend to infect multiple host species, (ii) pathogen persistence is often driven by a key host species, and (iii) targeting this key host species suffices for pathogen control.

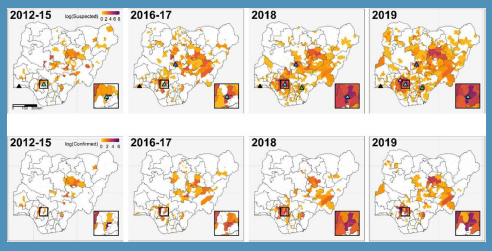
Contact: dr. Joachim Mariën; Joachim.marien@uantwerpen.be; Prof. dr. Herwig Leirs, Herwig.leirs@uantwerpen.be

## Mammal behavioral ecology and infectious disease transmission

Contact: Joachim Mariën

MP

- Invasion of new small mammal species as commensals in West Africa and the impact on Lassa virus epidemiology
  - Species distribution modelling, based on existing data
  - Spatial epidemiological models





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# Hannes Svardal and collaborators

University of Antwerp
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- Topics for master thesis and Individual Projects
  October 2023

- Understanding evolution using mathematical models and genomic sequencing data

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# Phenotypic diversity in sailfin silverside fishes

Contact:
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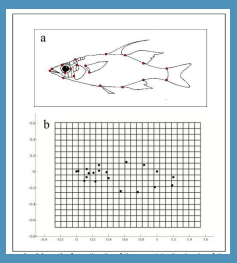
hannes.svardal@uantwerpen.be

Adaptive radiation of Sailfin silversides in Sulawesi
- Rapid speciation of 17 species of Telmatherina
- Different ecology and behavior

Master thesis project:
Body shape analysis of sailfin silverside fishes
- Ongoing hybridization between three species
- Intermediate phenotypes are common
- Body shape analysis will reveal which features can be used to identify the pure species




Schwarzer, 2005

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The sailfin silverside fishes in the Malili lakes in Sulawesi (Indonesia) are a diverse group of over 17 species with different ecology and behaviour. These fishes rapidly speciated in the lakes, making them a good example of an adaptive radiation. Evidence of hybridisation early in the speciation process and ongoing hybridisation make this radiation an interesting system to study the role of hybridisation in rapid species formation.

Three of the species of sailfin silversides from Lake Matano*, Telmatherina opudi, T. sarasinorum and T. abendanoni* show large differences in habitat and lifestyle, especially feeding behaviour. Despite their clear ecological separation, a continuum of intermediate hybrid morphotypes can be found in the lake, meaning they occasionally interbreed and produce viable hybrid offspring. To be able to study this hybrid swarm, we need a better understanding of what the pure species forms are.

In order to delineate the three groups, an analysis of the bodyshape of fish from the three species will be done. By comparing axes of differentiation, such as body depth compared to length, we aim to differentiate between the three pure groups, and to identify the hybrid individuals. Correlating the morphometrics analysis to information about the genome will reveal a lot about the effects of ongoing hybridisation on the speciation process of these fish.

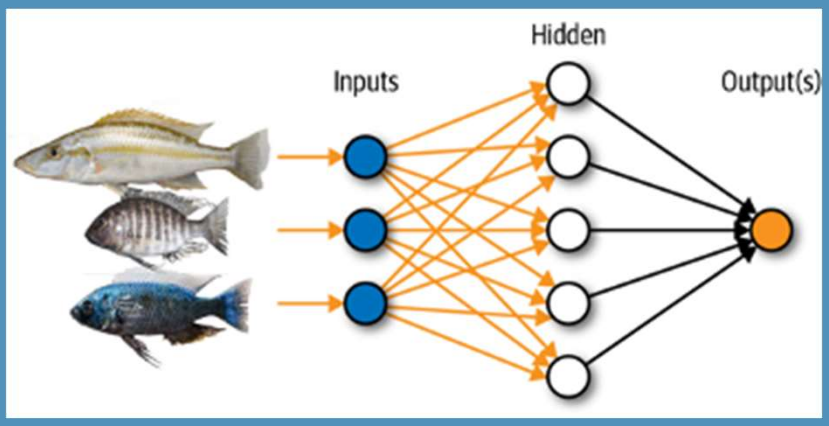
In this study, the student will collect and analyse data on the body shape of different species of sailfin silversides, and of hybrids between these species, in order to identify the axis of differentiation. The student will make the measurements based on photos and x-ray scans of the fish, and will be in charge of the statistical analysis and interpretation of the data. Based on the interests of the student, there are possibilities to include a comparison to genomics data of these same fish.

Contact:

Els De Keyzer, els.dekeyzer@uantwerpen.be

Prof. dr. Hannes Svardal, hannes.svardal@uantwerpen.be

# fishAI: A machine learning based tool to recognize individual fishes




contact: Hannes Svardal

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Image recognition is a poster child of machine learning and deep learning. In this project you will apply such algorithms (e.g., using the python package tensorflow) to develop scripts (or software) that can re-identify individual fish among the ~700 fish in our fish facilities from photographs and videos. Our facilities provide the perfect training data for such an approach. Both the developed approach and the knowledge gained have wide application potential.

Necessary background:
Knowledge in python programming. Prior knowledge/interest in machine learning will be useful.

Contact info:

- Promoter: Hannes Svardal (hannes.svardal@uantwerpen.be)

# How does a fish get its sex? Use genomic data to identify a newly evolved sex determination system

- in fishes, there is a variety of sex determination systems
- often variation at one or a few genes determines the sex of an individual.

- In this project you will use python or R or command line programs to analyse whole genome sequencing data of these fish and related species to understand which genes are determining their sex.

contact: Hannes Svardal

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In humans and most mammals sex is determined by the inheritance of the X and Y chromosomes. In fishes, however, there is a variety of sex determination systems, and often variation at one or a few genes determines the sex of an individual. In one species of cichlids fishes, *Copadichromis chrysonotos*, we found genetic differences between males and females that suggest a newly involved sex determination system. In this project you will use python or R or command line programs to analyse whole genome sequencing data of these fish and related species to understand which genes are determining their sex.

Necessary background: Basic knowledge of the unix command line and either python, R or a programming language is required for this project.

Contact info:

- Promoter: Hannes Svardal (hannes.svardal@uantwerpen.be)

MP or IP

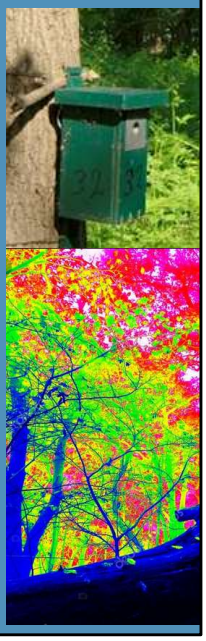
## Bird phenology, trees and climate change

Local variation in bird & tree phenology

- Based on long-term breeding data (25y)
- Spatial variation in tree budburst
- Measuring and/or modelling microclimate
- Focus on forest edges with different orientations

***Supervisor: Erik Matthysen***

***In collaboration with Ivan Nijs, Jonas Lembrechts (PLECO)***



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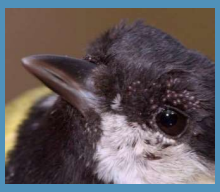
Insectivorous forest birds have become a prominent model to study trophic effects of climate change.
Briefly, as temperature in spring increases this triggers trees to develop their leaves; this in turn induces caterpillars to feed on the growing leaves, and birds are expected to time the laying of their eggs to coincide with the peak biomass of the caterpillars.
Many studies have shown that birds indeed lay their eggs earlier as springs become warmer. But very little attention has been paid to spatial variation within years and within forests. Neighbouring trees can differ strongly in their timing of leafing by one or two weeks, which can be due to their genetic background but also to local microclimate.
We propose a field project to test whether variation in timing of birds at a small spatial scale can be explained by individual timing of trees and/or by local microclimate. For this we use an area with small woodlots and many forest edges where we expect quite some microclimate variation. We also have 25 years of breeding bird data, so we can identify nest locations that have been consistently early or late, and then measure (or model) microclimate variation and examine tree phenology in the field.
Fieldwork will be done in spring 2024. Observations on birds or bird nests are not included, but optional.
This will be done in collaboration with the PLECO group.

MP

## Bird stress and tick-borne infections

Hypothesis: *Borrelia* infections are activated by stressful events in the host's lifecycle

Field experiment: increasing work load by brood size manipulations + testing birds for active infections (i.e. transmission of *Borrelia* to ticks)



Fieldwork in May 2024

***Supervisor: Erik Matthysen***

***In collaboration with Jens Zarka, Dieter Heylen***

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An important question in epidemiology is what explains seasonal and individual variation in infection in natural populations. Here we use a bird-tick-Borrelia system to test whether host stress induces activation of dormant Borrelia infections in the breeding season. We hypothesize that by increasing the workload, more Borrelia will be transmitted towards ticks.

In May 2023 a classic brood size manipulation experiment will be done where some nests receive more, or fewer, eggs. We know from previous years that roughly half of birds express infectiousness with Borrelia towards uninfected ticks. We predict that birds raising more young will result in more infected ticks. This will provide unique data on factors driving vector-borne pathogen transmission in the wild.

The student will be responsible for carrying out brood size manipulations and analyzing a number of physiological markers of stress (eg white cell counts, haematocrit…). Diagnosis of Borrelia in ticks will be done externally.

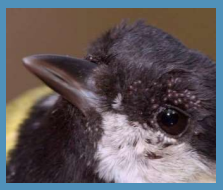
Field work is done in the area Lier-Hove-Lint.

MP, IP

## Host communities and tick-borne infections

Background: *Borrelia* infection of great tits vary between nearby forest fragments

Question: is this driven by local variation in host community (rodents, songbirds, larger mammals…)?



Fieldwork: bird and mammal surveys spring-summer 2024 (Lier)

***Supervisor: Erik Matthysen***

***In collaboration with Jens Zarka, Dieter Heylen***

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As part of our project on variation in *Borrelia* infections in great tits, we found surprisingly consistent variation between very similar woodland fragments (5-10 ha) at short distance from each other. This creates an opportunity to test hypotheses on the source of this variation. In this thesis project, the hypothesis will be tested that variation in infection is driven by differences in host communities whereby some host act as reservoirs for the infection, and others as dilution hosts (i.e. not suitable as reservoir). The focus is on *Borrelia garinii*, an important human pathogen that in the wild is only propagated by birds and not by rodents or mammals. Our prediction is that sites with higher *Borrelia garinii* prevalence in great tits have a higher contribution of bird hosts in the vertebrate community.

The field work will consist of different survey methods for birds (counts), rodents (trapping) and larger mammals (visual observation, tracks, possibly camera traps). The data on host abundance will be complemented with literature data on average tick burdens per individual, to estimate their contribution to the overall tick population.

MP

## Glowworms and artificial light at night (ALAN)

Background: some light colours have stronger effect than others on the males' ability to find glowing females.

Question: how does this translate into actual reproductive fitness?

Method: experimental matings in (semi-) field conditions (June-July 2024), monitoring egg and larvae production

***Supervision: Erik Matthysen,***
***Mira Van den Broecke***

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Belgium has three species of glowworms, two of them actually give light to attract their mates. The influence of light pollution (artificial light at night, ALAN) is an obvious concern, especially the increasing availability of cheap LED lights for garden illumination.

Previous research showed that ALAN reduces mating success in the common glow-worm (Lampyris noctiluca) because males are less able to detect the glowing females. Furthermore the effect depends on wavelength (colour) with red light having the least strong effect (possibly by masking the female's glow) while blue and white light have a stronger effect by inhibiting male activity.

Even though red light is often advocated as the least harmful for glow-worms (and other animals), there are no data on actual female mating success in (semi-)field conditions. If ALAN affects not only mate finding but also successful completion of mating, the impact of red light may be underestimated.

In this project females in (semi-)natural conditions will be exposed to different light colours while a male is added, and the mating, subsequent egg production and larval hatching will be monitored. Experiments need to be carried out in late June and first half of July. The student will have quite some flexibility in choosing locations and the design of the experiments which could be in the field and/or indoor.

MP, IP

## Movement and corridor use in Natterjack Toads

Compare two monitoring techniques for tracking NJ corridor use: camera traps and bluetooth loggers

Analyze individual and seasonal variation in movement patterns (incl camera data of 2023)

Test effectiveness of artificial corridors in the Port of Antwerp

Field work ± april – august 2024 (flexible), assisted by volunteers

***Supervision: Erik Matthysen, Johan Baetens (Natuurpunt)***

University of Antwerp Evolutionary Ecology Group

IoSA Internet of Small Animals

Port of Antwerp Bruges International

Natuurpunt Waasland

Natterjack Toads (Rugstreeppad) are a priority species for the Species Conservation Programme in the Port of Antwerp. Connection of subpopulations is a vital element in this Programme, and recently artificial corridors (overpasses, tunnels) were constructed, but their effectiveness remains to be demonstrated.
In 2023 we did a pilot study with Natuurpunt using two innovative monitoring techniques: camera traps specifically designed for small ectotherms, and individual loggers with bluetooth connection. Results are promising but the full deployment of the corridor monitoring will be done in 2024.
In this Master Project you will analyze camera data of 2023, and install the two monitoring systems in several corridors in spring-summer 2024, with the help of volunteers who will assist in trapping and monitoring toads. In addition to the applied aim of documenting extent of corridor use, fundamental questions can be answered with the data about individual and seasonal variation in movements.

Field work is from april to august, probably most intensive in april and may but can be filled in flexibly

A driving licence will be required.

# Extra information – *Erik Matthysen*

Felasa accreditation is required only for the brood size manipulation project.

For all fieldwork, having a driving licence is a bonus because then you can drive to the field independently (possibly by using a car of the department). An alternative can be by bike, if you live nearby, depending on how much material needs to be taken.

Most of the great tit fieldwork will be in the area Lier-Boechout-Hove, not too far from the campus.

Contact: erik.matthysen@uantwerpen.be

Best to make an appointment for additional information

University of Antwerp
Evolutionary Ecology Group

# Conservation genomics at Zoo

- https://www.zooscience.be/nl/ons-team/philippe-helsen/

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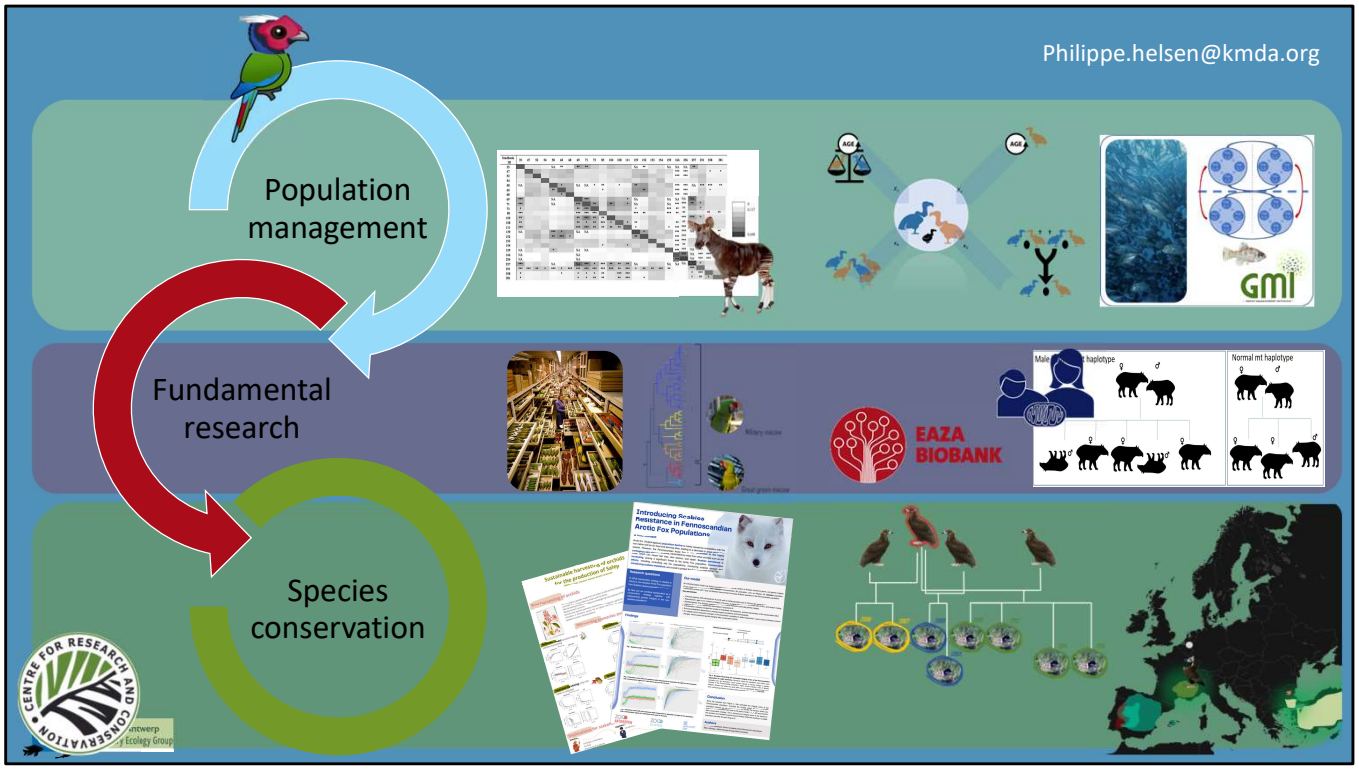
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