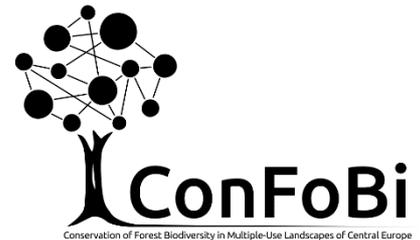


## Offer: PhD Thesis! (not funded yet)

Note: a pilot study on this topic would be suitable for **MSc thesis** work.

# Multi-scale relationships between large herbivores and forest structure and biodiversity



Plant communities have co-evolved with herbivores, and herbivory can shape the structure, composition and dynamics of forest vegetation. Large herbivores (LH) in particular, mainly through grazing and browsing, may create and maintain open forest structures favourable for light-demanding communities, which are highly valued by nature conservation (Reimoser & Putman 2011, Bakker et al. 2016, Boulanger et al. 2017). Further, LHs such as deer Cervidae may enhance primary production (De Mazancourt et al. 1998), influence nutrient cycling via their urine and faeces (Bakker et al. 2004), disperse seeds via epi- and endozoochory (Iravani et al. 2011), and provide resources for secondary consumers and decomposers (Smit & Putman 2011). Despite their numerous contributions to ecosystem functioning and biodiversity, forest managers in Germany and elsewhere, promote the exclusion of LHs such as Roe deer *Capreolus capreolus* and Red deer *Cervus elavus*, the major LH species of central Europe, as a measure to favour high tree species richness, and thus biodiversity as a whole (Ammer et al. 2010, Putman et al. 2011).

This study aims at assessing the impact of LHs on forest structure and biodiversity. The study supplements existing ConFoBi projects by contributing information on large herbivores both as a significant component of biodiversity, as well as an important driver of forest structure. Across the ConFoBi pool of study plots, the project will quantify relative abundance of red deer and roe deer based on pellet count (e.g., Amos et al. 2014) and camera trap (e.g., Burton et al. 2015) methods at stand levels, supplemented by hunting bag records at the landscape level. In a multi-scale analysis, LH abundance will then be related to forest structure and biodiversity components quantified in other ConFoBi projects. The effects of roe deer on vegetation will be assessed by surveys of browsing intensity on food plants (e.g., Suchant et al. 2010). For recording variability of roe deer diet composition across plots and seasons, stable isotopes will be analysed from faecal pellets (Ben David & Flaherty 2012, Nájera-Hillman & Mandujano 2013). The role of deer endozoochory in seed dispersal will be studied based on germination experiments from faecal pellets (Myers et al. 2004, Iravani et al. 2011). Based on an Intermediate Disturbance Hypothesis (IDH; Connell 1978), maximum plot-level biodiversity can be expected at intermediate LH abundance and browsing pressure. Plot-scale and landscape deer abundances,

respectively, are expected to be shaped by structure and composition of the vegetation as well as hunting practices and human disturbance through recreational activities (Milner et al. 2006, Coppes et al. 2017).

In particular, the study will address the following aspects: (Candidates are expected to develop their own project proposal based on the ideas sketched here in cooperation with the ConFoBi coordination).

- Relative abundance of roe deer (and other large mammals) on the 135 ConFoBi plots
  - Camera traps, all seasons
  - Pellet counts, all seasons
- Roe deer diet composition from faeces (C3/C4) using stable isotopes
  - Short-term variability in diet composition
  - Among-plot differences in deer diet composition
- Occurrence and intensity of deer browsing on tree species and other forage (*Rubus* spp., *Vaccinium* spp., etc).
  - Summer browsing, Winter browsing
- Effects of deer browsing on tree species composition / vegetation
  - Evaluation according to existing forestry standards (e.g., Suchant et al. 2010)
  - Assess susceptibility of forest regeneration to deer browsing in relation to forest structure and alternative food plant availability
- Role of deer as seed dispersers (endozoochory)
  - Seeds in roe deer faeces; germination experiments (Myers et al. 2004)
- Role of deer for forest biodiversity
  - Review existing studies, and critically compare findings and conclusions
    - (a research field full of prejudices and value judgements...)
  - Correlate relative abundance of roe deer with measures of forest structure at plot level and landscape level (A1, A2)
  - Correlate occurrence of roe deer with occurrence and diversity of plant and animal taxa

### Methods

- Study area: all 135 ConFoBi plots (field work) and their surroundings (background info on hunting management)
- Pellet counts (plot-level; transects, distance sampling; in all seasons)
- Camera traps (plot-level; throughout the year)
- Browsing surveys (summer and winter browsing)
- Pellet sampling; stable isotopes analysis for seasonal and spatial (among plots) differences
- Pellet sampling; seed germination experiments
- Bag record data and info on hunting management: state forest service

### Data from /cooperation with other ConFoBi projects:

- Forest structure, plot and landscape scales (data from A)
- Occurrence of plant and animal components of biodiversity (data from B)
- Ground vegetation on plot (composition, height, vertical structure, ...)???
- Site characteristics (climate, soil, ...)???
- Stakeholder attitudes towards the role of herbivores for forest biodiversity (coop with C, D)

## Finances/Equipment required

- PhD position or scholarship
- Travel and field assistant costs
- Camera traps (ca. 80 available)
- Seed germination experiments – glasshouse space / coop partner
- Stable isotope analysis

## Academic supervisor

Prof. Dr. Ilse Storch, Chair of Wildlife Ecology & Management, University of Freiburg

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