FunDivEUROPE

Functional significance of forest biodiversity in Europe

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Mammalian herbivory assessment

FunDivEUROPE (FP7) field protocol

V1.0

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Content

1 Introduction

Mammalian herbivory is an important source of tree mortality during the early stages of stand establishment. Even when mammalian browsing is moderate and does not kill the tree, it often detrimentally affects timber quality and forest regeneration. Therefore, reduction of mammalian herbivory is important in forest management. Existing empirical evidence of the effects of forest diversity on mammalian herbivory is scarce and anecdotal and largely comes from observational studies. Unlike many insect pests, mammalian herbivores are usually polyphagous and it appears that susceptibility of trees to generalist mammalian browsers may increase rather than decrease with the tree species diversity of a stand. Studies on effects of forest diversity on mammalian herbivory performed within this task will elucidate whether potential increase in mammalian browsing outweighs other benefits of forest stand diversification such as reduction in damage by specialized insect pests and increase in beneficial organisms for pest regulation ("Assessment of forest insect and pathogen damage on mature trees" and "Abundance of beneficial organisms for pest regulation".

2 Scope and application

Studies of mammalian herbivory will be conducted mainly in Exploratory Platform because majority of Experimental sites are fenced to exclude mammalian herbivory and inventories are unlikely to provide comparable and sufficient information on damage agents.

At each Exploratory region mammalian herbivory monitoring will be conducted on all main tree species contributing to the diversity gradient (all trees >1.3 m, according to our internal definition). Mammalian herbivory on woody saplings/seedlings <1.3 m will be done in three quadrates (1 m^2 each) per plot.

In addition, sentinel tree saplings ("phytometers") will be planted at a subsample of plots per region (for tree species with two best diversity gradients). Half of them will be inside the enclosure (mammalian herbivory exclusion) and half of them will be exposed to herbivory. One of the planted species will be a conifer and another one a broadleaf species selected among the dominant tree species in each site. The same phytometers will be used for assessment of insect herbivory, tree pathogens and predators and parasitoids.

3 Objectives

To assess the amount of damage (browsing and bark damage) caused by different mammalian herbivores in low and high diversity forest stands.

4 Location of measurements and sampling

4.1 Field sampling design and number of replicates

Browsing damage and bark damage will be estimated at:

- For trees > 1.3 m in height: at five trees per species per plot (i.e. five trees in monocultures, 20 trees in four species mixtures);
- For woody saplings/seedlings <1.3 m in height: at all saplings present within three quadrants (1 m^2 each) per plot;
- For phytometers: at nine uncaged saplings per species per plot (18 in total).

The same trees (>1.3 m) as for insect herbivory monitoring will be used.

4.2 Frequency of sampling

Mammalian herbivory monitoring will be conducted once a year in each Exploratory region. The best time for browsing monitoring in boreal and temperate regions is spring after the snowmelt (easier to see browsing damage when foliage is absent).

5 Measurements

5.1 Browsing damage

The twig count method (Shafer 1963) will be used to estimate the amount of biomass browsed. First, the average bite diameter will be determined for each tree species. Then samples of branches of the same diameter from unbrowsed trees will be collected, oven-dried for 48 hours at 70^0 C and weighed. This will allow establishing average weight of browse material for each tree species. Once this initial information is collected, counting the number of browsed twigs per tree will provide data that can be converted to biomass browsed.

Three types of browsing damage will be distinguished:

- Browsing of the current year's leader shoot;
- Browsing of the lateral shoots;
- Stem breakage (by moose or deer).

In most cases it is not possible to distinguish between browsing damage caused by different species of ungulates, therefore damage agents will be classified as ungulates vs. rodents/lagomorphs (rodents and lagomorphs cleanly clip branches, whereas ungulates leave a ragged edge). In addition, we will measure stem diameter (30 cm from the ground) for each assessed tree/sapling and the height of the phytometers inside and outside of the exclosures. At the end of the experiment phytometers will be harvested and their aboveground dry biomass will be measured and compared for inside and outside exclosure plants.

5.2 Bark damage

Many mammalian herbivores cause bark damage by either feeding on the bark (e.g. voles, hare, rabbit, deer) or by rubbing against the trees (e.g. deer, wild boar). Most bark wounds heal over and may not have serious consequences for the tree. However, bark wounds often serve as entry points for decay fungi and extensive wounds around the stem circumference (girdling wounds) may cause dieback of the stem above the wound.

Bark damage will be classified into three categories:

- Minor: girdling wounds which are < 25% of the stem circumference or wounds with combined length of < 25% of length of the stem for trees < 5 m in height/< 25 cm in length for trees > 5 m in height.
- Moderate: girdling wounds which are 25-50% of the stem circumference or wounds with combined length of 25-50% of the stem for trees < 5 m in height/25 cm-1 m in length for trees > 5 m in height.
- Severe: girdling wounds which are > 50% of the stem circumference or wounds with combined length of > 50% of the stem length for trees < 5 in height/>1 m for trees > 5 m in height.

Likely damage agents will be identified by teeth marks and character and height of the wound (Bang and Dahlstrom 2006) and recorded.

6 Template for a data sheet

Template for a data sheet for recording browsing damage and bark damage (tree-specific measurements). Three separate data sheets will have to be used (for trees > 1.3 m, for saplings < 1.3 m and for phytometers.

Date	Recorder	Region	Plot No	Diversity level/ species composition	Tree species	Tree No/ID	Stem diameter (mm)	Type of browsing damage	No browsed shoots	Bark damage
					FASY PISY			L – leader shoot S – side shoot B – broken stem	For side shoots only	1 – minor, 2 – moderate, 3 - severe

7 References

Shafer E.L. (1963). The twig-count method for measuring hardwood deer browse. *Journal of Wildlife Management* **27**, 428-437.