

Bioindicators for measurement of red deer pressure on understory vegetation in temperate deciduous forests

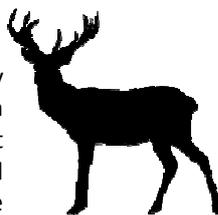
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Context

During the last decades, populations of large herbivores have largely increased. Consequently, their pressure on forest vegetation has been exacerbated, reaching in some cases levels that reduced the diversity of forest ecosystem services. Assessing the balance between timber production and hunting activities remains a crucial question for forest managers who hence need reliable tools such as ecological indicators.



Objectives

Our aim was to review ecological indicators that characterize the pressure of red deer (*Cervus elaphus* L.) on understory vegetation in temperate deciduous forest ecosystem.

Indicators

VARIABLES

The characteristics of the understory vegetation indicating environmental changes are:

- Cover
- Height
- Stem density
- Biomass
- Species diversity

- Herbaceous stratum
- Forest regeneration

INDICATOR PLANTS

These indicators can be estimated from different groups species. These plants belong to:

The choice of plants on which the variables are measured is crucial to accurately characterize the deer pressure. This choice must take into account the feeding behavior of red deer, silvicultural objectives, ease of the measurement and the occurrence of these plants within the studied habitat. Generally, it is more appropriate to use common species with a wide ecological amplitude.

Variables	Indicator plants
Cover	Herbaceous stratum
	Bramble (<i>Rubus</i> sp.) Bilberry (<i>Vaccinium myrtillus</i> L.)
Stem density	Forest regeneration
	Forest regeneration
Height	Bilberry
	Heather (<i>Calluna vulgaris</i> Hull.)
Biomass	Forest regeneration
	Bilberry
Species diversity	Herbaceous stratum
	Forest regeneration



Effect of plant abundance and palatability

The choice of indicator plants must take into account plant abundance and palatability, as they both affects considerably the performance of the ecological indicator.

The variability of indicators generally increases with the scarcity of the chosen indicator plant. Therefore, choosing abundant plant species appear often the best solution as the resulting have a lower variability and hence enable better to detect changes of deer pressure.

At low herbivore pressure, palatable species to offer quick response to the pressure variations (Figure 1). Palatable species are therefore reliable plant indicator especially if these is a good balance between game population and forestry.

At excessive herbivore pressure, non-palatable species are preferred (Figure 1). In this case, the variability of ecological indicator is smaller with non palatable plant than with palatable plant.

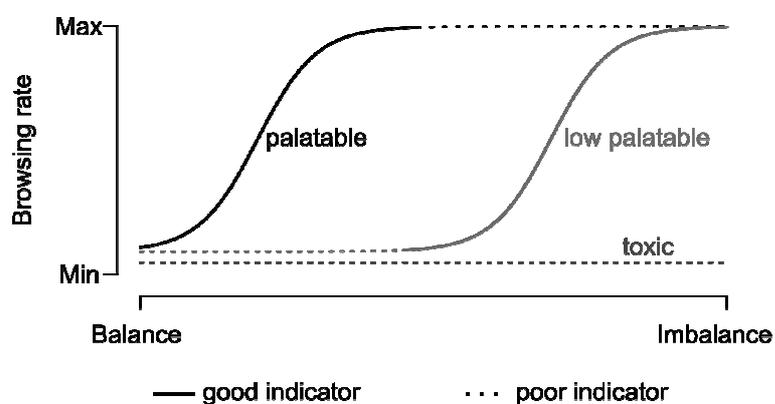


Figure 1. Evolution of indicators efficiency by browsing rate, palatability and balance between game population and forestry.

Conclusions

Ecological indicators of deer pressure help to understand the relationships between biodiversity, carrying capacity and deer populations. They are intended to forest managers that would like to monitor red deer pressure in regards to forest management goals and forest sustainability.