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FOREST FACTS

Photo: Per Ahlroth (lower right), Anders Jarnemo.

Alternative forage reduce deer browsing pressure on spruce around supplemental feeding sites

Pablo Garrido and Petter Kjellander

In 28 % of the investigated plots, **deer browsing on Norway spruce** was observed.

About **9 % of all shoots per tree were browsed** (0.5 – 4 m above ground).

Browsing pressure ceased at around 200 m from supplemental feeding sites.

Abundance of alternative natural food, such as field layer and deciduous trees, was the **most important factor** affecting browsing pressure on spruce.

Planting Norway spruce to avoid browsing damages is **not a definitive solution**, and we suggest managers to **locate supplemental feeding sites at places with an abundant field layer** to minimize browsing damages by large herbivores.

Herbivores are important species for ecosystem functioning, and crucial ecosystem drivers when predators are absent. In the last 50 years, a significant increase of large herbivore populations has occurred. This has led to dense deer populations for which management is necessary to prevent damage. Based on this need, winter supplemental feeding has become a widespread management practice to sustain high densities

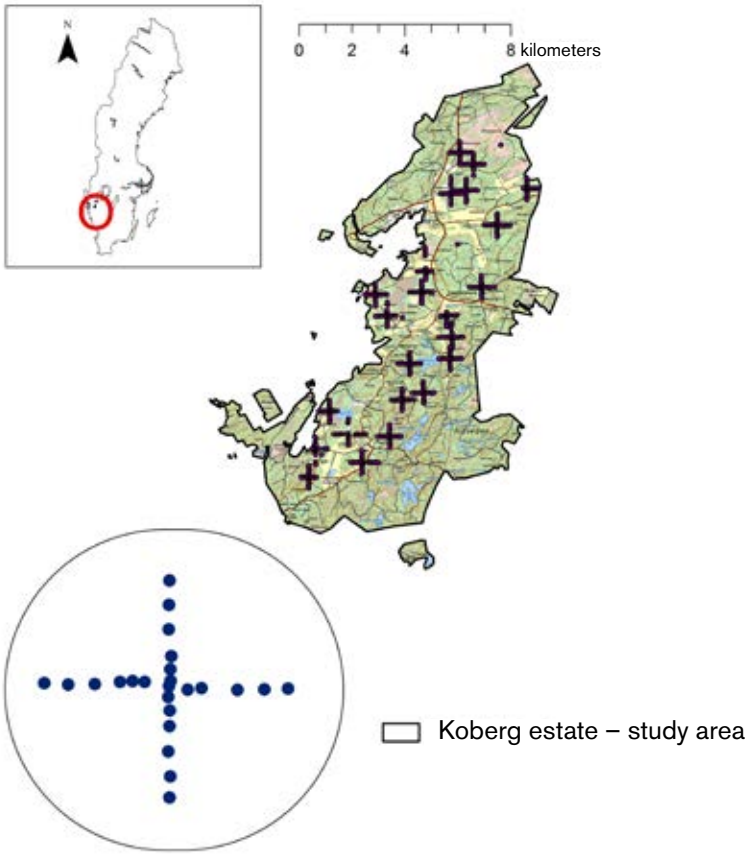

Figure 1. Study area location in southwestern Sweden at the Koberg estate. The distribution of supplemental feeding sites is shown as well as the detailed study design in relation to the selected sites.

of ungulates, e.g. red and fallow deer, and wild boar. It intends to steer deer spatial movements in order to prevent damages in valuable trees or crops, as well as to support winter survival and enhance fitness, often for hunting purposes. There are three main causes of tree damage by deer. It can be due to browsing, bark stripping, and fraying trees with the antlers. Moreover, most deer species browse on conifer tree species in winter, and consume broad-leaved tree species during summer time. Landowners are often interested in managing both forest and game, although either research or management tools are lacking. Management is thus typically based on trial and error strategies. Yet, high deer densities usually cause damages to valuable trees, e.g. pine, by browsing, and consequently less preferred tree species such as spruce are increasingly being planted. In this study, we investigated the effect of winter supplemental feeding practices on the browsing pressure caused by deer on young spruce (0.5 – 4 m high), in relation to distance to supplemental feeding sites and available natural forage.

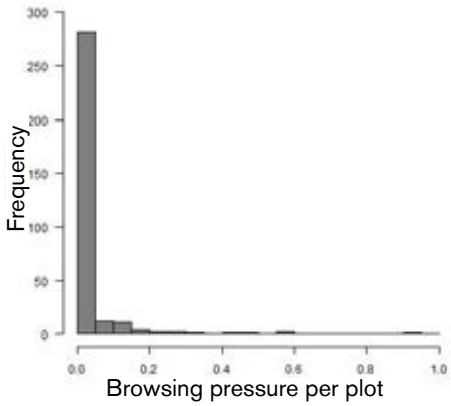

Figure 2. The frequency of surveyed plots (n=319) at different browsing pressure intervals. The X axis denotes upper interval limits of browsing pressure. Bars were generated in 5 % intervals.

How did we do it?

The study was performed in southwestern Sweden, at the Koberg estate (Figure 1). A total of 24 supplemental feeding sites were selected. At each feeding site, six plots (4 m radius) were systematically surveyed in every cardinal direction at 0, 50, 100, 200, 300, and 400 m from the artificial feeding site (Figure 1). In order to estimate browsing pressure, all available and browsed twigs on Norway spruce trees (< 1 m and/or 1–4 m height) closest to the plot center were counted. GLM statistical models were used in order to assess the browsing pressure on young Norway spruce and to estimate the extent of previously identified factors related to browsing occurrence around supplemental feeding sites. Natural forage in this study included blueberry, lingonberry and heather (field layer), deciduous tree species (mainly birch) and Scots pine.

Results

Norway spruce was found in a total of 319 of 557 sampled plots.

We found that almost 28 % of the investigated plots with spruce had signs of browsing (88 out of 319) at the study area. On average 9 % of all shoots were browsed per surveyed tree (Figure 2). The browsing pressure was much higher adjacent to supplemental feeding sites (Figure 3), and decreased with distance. The most important factors explaining browsing pressure on spruce were distance to supplemental feeding sites, and the amount and abundance of natural food in the field layer and among deciduous trees. The model explained almost 50 % of the total variation in browsing pressure on spruce. Browsing ceased on average at around 205 m from the supplemental feeding sites (Figure 3). However, the relationship between browsing pressure and distance varied greatly as revealed by the confidence intervals (Figure 3), ranging from 0 to 36 %. Furthermore, when alternative natural forage was abundant (in particular the field layer), the browsing pressure was substantially lower already adjacent to supplemental feeding sites (Figure 4A), whereas the occurrence of deciduous trees had a lesser effect on the found browsing pattern (Figure 4B).

Management considerations

The results suggest managers to locate supplemental feeding sites based on:

(1) stands with an abundant field layer and (2) stands with at least 20 % of deciduous tree species in order to minimize browsing impacts (Table 1) on commercially valuable tree species. Forest managers should especially aim for sites with an abundant field layer (Figure 4A). Adapting forest management practices to increase the amount and abundance of the field layer is important when practicing multi-purpose management, i.e. to minimize browsing impacts while maintaining high deer densities for hunting (Figure 4). Furthermore, the results indicate that planting spruce does not necessarily prevent deer from browsing on commercially valuable less preferred tree species. Besides the importance of available natural forage, other environmental factors might affect the browsing pattern, such as deer species community composition and densities as well as forest stand structure and composition. Unfortunately, we were not able to include all these factors in our analysis.

Finally, in areas with high population densities of group living deer species, particularly fallow and red deer, subdominant animals, i.e. females and juveniles, spend many hours every day around the feeding sites waiting for dominant adult males to leave. It is likely then that most of this browsing on spruce occurs while waiting. To avoid such possible effects of social dominance, a simple management action may be to redistribute large feeding sites into several smaller ones, dispersed over larger areas, in order to allow low ranked individuals access to supplemental forage, and thus reduce browsing on adjacent spruce.

Even-aged forest	Field layer presence	Deciduous trees	Affected buffer distance	Browsing levels
Spruce	Low	0 %	> 200 m	Up to 36 %
Spruce	Medium	5 %	~ 200 m	Medium, ~3 %
Spruce	High	20 %	< 200 m	Low, < 1 %

Table 1. "Traffic light" table for managers' identification of better habitats for optimal location (minimal browsing damage) of supplemental feeding sites.

Future practices?

Even-aged forest management (e.g. clear cutting) might not be the best suited silvicultural management practice when both game and timber yield are to be maximized. Today multi-purpose management and practice is rare and challenging since knowledge is lacking. The present legislation also creates obstacles. In spite of this, there are estates and landowners that do try to optimize both goals. It is obvious to us that research has to address these issues more clearly. To date, clear cutting is utilized in ca. 96% of the managed forest in Sweden. To allow for a continuous cover of field layer (in this study including blueberry, lingonberry and heather) and thus minimizing browsing pressure on commercially valuable trees to negligible levels, a continuous tree cover should be maintained at stand level. An alternative solution is the gradual adoption of naturally regenerated uneven-aged forest stands that would possibly have more favorable effects in multi-purpose management scenarios. There are probably many possible management alternatives better suited for multi-purpose forest management that could be adopted, however our mind set has to shift accordingly to step out of the monoculture-production oriented paradigm, and alternatives should be adopted with caution. Recent studies in Sweden also pointed out a substantially higher tree biomass production in mixed stands, and a higher delivery of ecosystem services related to higher levels of biodiversity. New research is also advancing knowledge on the socio-ecological implications of ecosystem services provision by modifying forest rotation lengths. Further, climate change mitigation and first insights on replacing monocultures by mixed species stands in Sweden are being investigated.

Finally, stand structural heterogeneity has been correlated to lower frequencies of damage under near natural forest (multi-layered) conditions, due to higher abundance of available forage. Even if the adoption of multi-purpose forest management practices will pose a greater management

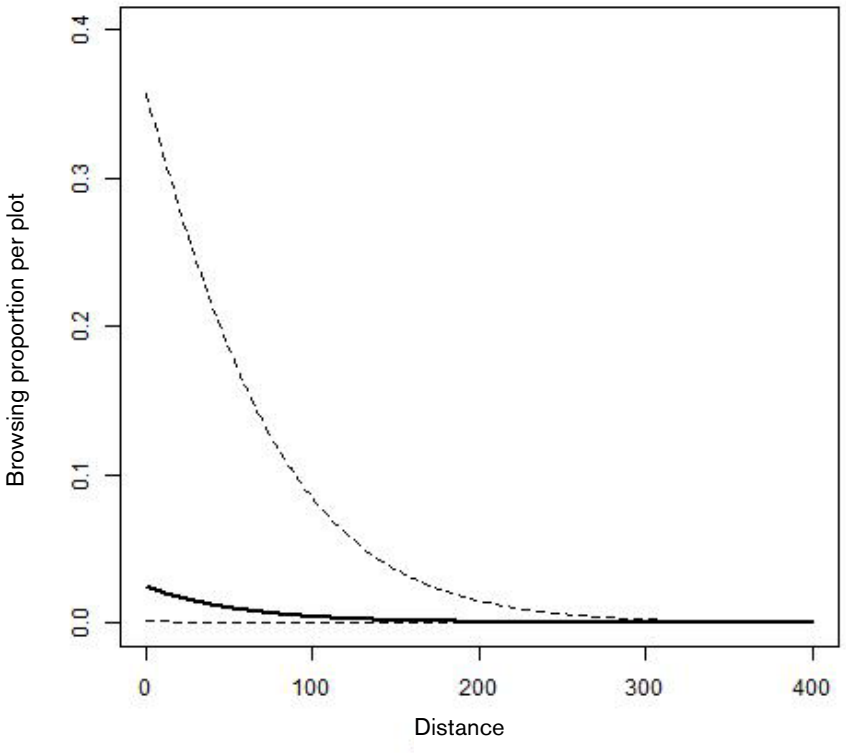

Figure 3. The relationship between browsing pressure and distance to supplemental feeding sites (black line), obtained by including all factors and interactions in the model. The 95 % confidence intervals are also shown by dashed lines.

complexity, current societal demands urge us to work in that direction, particularly in Southern Sweden, to allow for the provision of multiple ecosystem services. Yet, further studies such as cost-benefit analysis should also be performed in order the asses its potential use and extension not least in relation to agricultural damages and future climate change scenarios ■

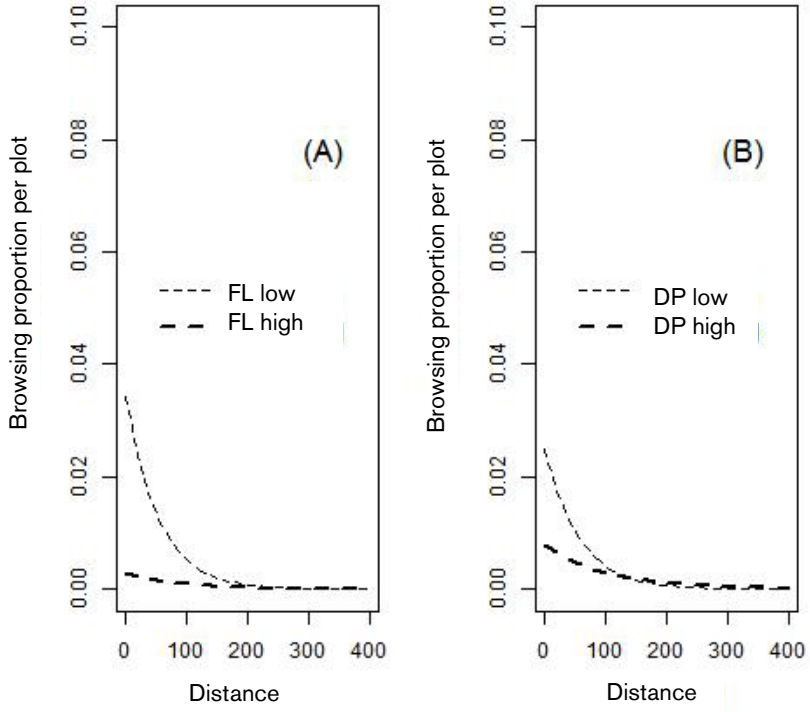

Figure 4. Illustration of interaction effects of distance and (A) field layer (FL), and (B) deciduous tree proportion (DP), with predicted browsing pressure on spruce. Pine was also tested showing non-significant results, and therefore not presented.

Keywords
Browsing pressure, fallow deer, *Dama dama*, multi-purpose management, Norway spruce, supplemental feeding.

Read more

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Authors

Pablo Garrido-Rodriguez
PhD student,
The School for Forest Management,
SLU, Box 43
SE-739 21 Skinnskatteberg
Pablo.Garrido@slu.se

Petter Kjellander
Professor,
Grimsö Wildlife Research Station, Department of Ecology, SLU,
SE-730 91 Riddarhyttan
+46-581-69 73 37
Petter.Kjellander@slu.se

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