

## 2.5 Game Browsing Damage Survey

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### 2.5.1 Introduction

The recording, assessment, and evaluation of young growth that is browsed by ungulates are difficult; nevertheless, it ranks high in today's applied silviculture. The severe strain that is placed onto the forests, as well as onto the cultural landscape through recreational activities, results more and more in driving the deer (*Capreolus capreolus* and *Cervus elaphus*) and chamois (goat antelope native to the mountains of Europe and Asia) out of their traditional habitat. This leads to serious browsing intensities locally, so that natural forest regeneration, to some extent, is only possible under aggravated conditions.

In the first NFI the current browsing of the terminal shoot by ungulates was reported, which means that it was recorded whether the terminal shoot was browsed or not. As the analysis from the first result publication demonstrated, the browsing percentage (e.g., the proportion of browsed plants as compared to the total number of plants) was subject to strong seasonal fluctuations (EAFV 1988). Depending on the time of recording, these fluctuations led to varying results. The results, furthermore, deviated from the annual browsing according to EIBERLE (1980; 1985), which estimated how endangered the regeneration was.

Due to this fact, the methods for evaluating the browsing damage were fundamentally revised (STIERLIN *et al.* 1994). Because of the modified browsing evaluation, the seasonal effects were compensated. However, the data of both inventories were no longer directly comparable.

Based on case studies, both methods of evaluating the browsing damage were compared with each other.

### 2.5.2 Browsing Evaluation in the NFI1

In the first NFI all tree and shrub species with a height of 30 cm or more were counted as young growth. For the browsing evaluation, a plant was labeled as browsed when the terminal bud of the main shoot was browsed at the time of the recording (ZINGG and BACHOFEN 1988).

The following five browsing patterns (Figure 1) represent the plants, which were assessed as browsed in the first NFI, even though the patterns differ considerably.

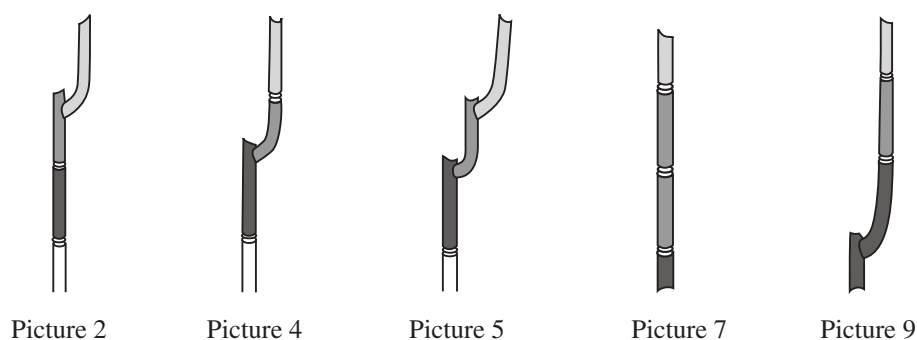


Figure 1. Browsed plants according to the NFI1 definition.

In case the terminal shoot was still intact, the first NFI method labeled the plant as not browsed (Figure 2), even if browsing damages that occurred earlier were clearly visible.

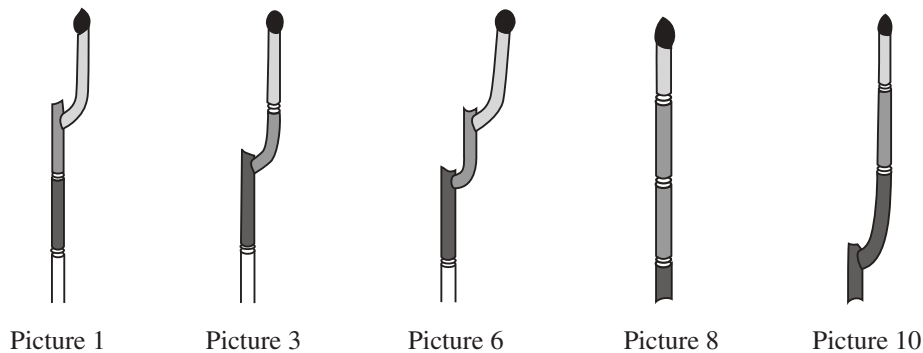


Figure 2. Plants not browsed according to the NFI1 definition.

### 2.5.3 Browsing Evaluation in the NFI2

In accordance with the study conducted by EIBERLE (1980; 1985), the survey method for assessing the forest regeneration and the browsing rate was adjusted, so that the young growth plants taller than 10 cm were assessed. The plants were divided into four young growth size classes (10–39 cm, 40–69 cm, 70–99 cm, 100–129 cm) and three diameter classes (0–3.9 cm DBH, 4–7.9 cm DBH, 8–11.9 cm DBH) (STIERLIN *et al.* 1994).

The survey method developed for the second NFI attempted to minimize seasonal fluctuations. This was successfully accomplished by backdating the browsing incident, which means that their assessment was conducted over a longer period of time. If below the terminal bud (independent of their conditions) two visible traces of scales were found without any signs of browsing inbetween (where at least the two latest—former terminal buds were not browsed), the plant was considered as not browsed. In all other cases the plant was considered as browsed.

The following browsing patterns (Figure 3) show plants which were considered browsed according to the second NFI method.

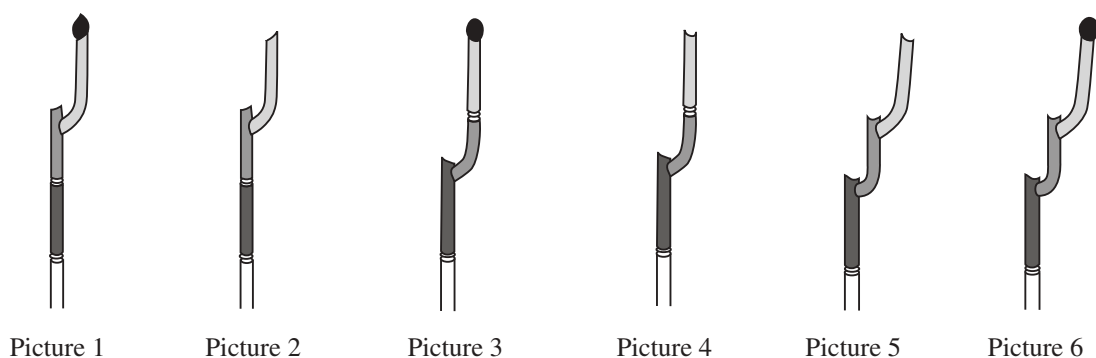


Figure 3. Browsed plants according to the NFI2 definition.

In contrast to the above, the following plants (Figure 4) were not considered browsed, even though they also displayed some signs of browsing.

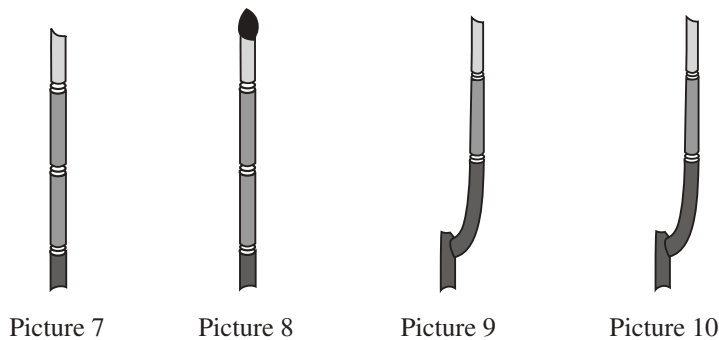


Figure 4. Plants not browsed according to the NFI2 definition.

#### 2.5.4 Additional Study for “Game Browsing and Plant Reaction”

In order to be able to compare the data of the browsing rate presented in the second NFI with the acceptable browsing rate of individual tree species published in EIBERLE (1985), EIBERLE and ZEHNDER (1985) and EIBERLE and NIGG (1983; 1987), it was imperative to know what the annually-occurring browsing rate of the terminal shoot was from individual plants. For this, the browsing percentage depended on the reaction of the individual plants (St. John’s shoots, substitute shoots), as well as on the browsing rate of the ungulates during the course of the year.

The annual browsing damage could not be directly interpreted in a large-scale inventory, because the survey lasted from the spring until late fall. Due to the plants’ reaction, it was not possible to clearly allocate the browsing event to a certain year. Additional surveys in the forest, and shoot cutting experiments in the nursery, provided the necessary information to interpret the NFI browsing data.

#### *Experimental Design and Method*

##### *Field Trial*

The additional surveys in the forest were case studies and were not representative of the entire country of Switzerland. The experimental plots were selected based on preceding data analysis of the first NFI. For this trial, all altitudinal vegetation zones (see Chapter 3.1), as well as the five main tree species: spruce, fir, European beech, ash, and maple were present when possible. In addition to this, a high proportion of plants browsed by deer (*Capreolus capreolus* or *Cervus elaphus*) had to occur on these plots. In each experimental plot, 50 plants were selected and permanently marked.

Between 1996 and 1997, all plots were visited three times a year (before the beginning of the growing season, during the growing season, and after the end of the growing season). The young forest growth was examined with respects to browsing events and growth reaction. In addition, the course of growth of selected plants was documented with sketches. With this information it was possible to report about the periodicity of the browsing rate in the summer and the winter months.

The following variables were measured at the field plot:

- The seasonal trend of the browsing situation
- The proportion of browsing damage patterns according to the NFI2 inventory manual (STIERLIN *et al.* 1994)

- The browsing rate
- The plant reaction typical for the tree species after occurrence of a browsing incident

#### *Nursery Experiment*

In contrast to the open field trial, the conditions in the nursery experiment, which was started in the spring of 1996, were relatively homogeneous. All plants were planted in identical substrate and were kept under the same climatic conditions. For this experiment 125 plants for each of the 5 main tree species (spruce, fir, European beech, ash, maple) were used from lowland provenience (Table 1).

As a result of the constant monitoring and care, the plants were not exposed to any excessive stress situations (dryness, too intense solar radiation, etc.). The plants were subjected to one or more winter and summer browsing damages, which were simulated by pruning the shoot. Pruning took place during the end of March/beginning of April and the end of July/beginning of August. The treatment was limited to pruning of the terminal shoot. The side shoots were not pruned.

Table 1. Type of plants in the nursery experiments.

Type	Location	Provenience		Age (year)	Transplanted Yes/No
		Elevation (meters above sea level)	Exposition		
Spruce	Tägerwilen	520	North	2	No
Fir	Beinwil/Horben	820	North-east	3	Once
Ash	Besenbüren	470	North	1	No
Beech	Hirschthal	600	South-west	1	No
Sycamore maple	Muri/Maiholz	450	East	1	No

The plants were subjected to the following treatment:

1. No treatment
2. One time pruning of the shoot in the spring of 1996
3. One time pruning of the shoot in the summer of 1996
4. Pruning in the spring of 1996 and in the spring of 1997
5. Pruning in the summer of 1996 and in the summer of 1997

The goal of the pruning experiment, in addition to the field experiment, consisted of obtaining a foundation for the interpretation of the browsing evaluation results for the NFI.

The following quantities were observed:

- The time and frequency of substitute shoots after pruning a shoot
- The dependency between plant growth and the treatment
- The frequency of growing St. John's shoots from intact terminal buds

The statistical design of this experiment (SACHS 1992) was a randomized complete block design (RCBD) with five replications.

The measurements in the nursery started before the beginning of the leafing and were usually repeated every three weeks. This ensured that the annual development of the plant growth and the plant reaction after the shoots were pruned could be completely described.

## 2.5.5 Results

### 2.5.5.1 The NFI1 Method

Because of its simplicity and low expenditure, the NFI1 method was attractive and should have been preferred; however, it had a significant shortcoming. Using spruce as an example in the pruning experiments (Figure 5) showed that under optimal conditions at the nursery, many of the young trees outgrew the browsing damage very quickly during the growing season. This led to external damage being no longer noticeable (shifting from browsing patterns 2, 4, 7, and 9 to browsing pattern 8). After a browsing event, substitute shoots grew even more quickly from the plants (changing from browsing patterns 2, 4, 7, and 9 to browsing patterns 1, 3, 6, and 10, which were not counted as browsed according to the first NFI method).

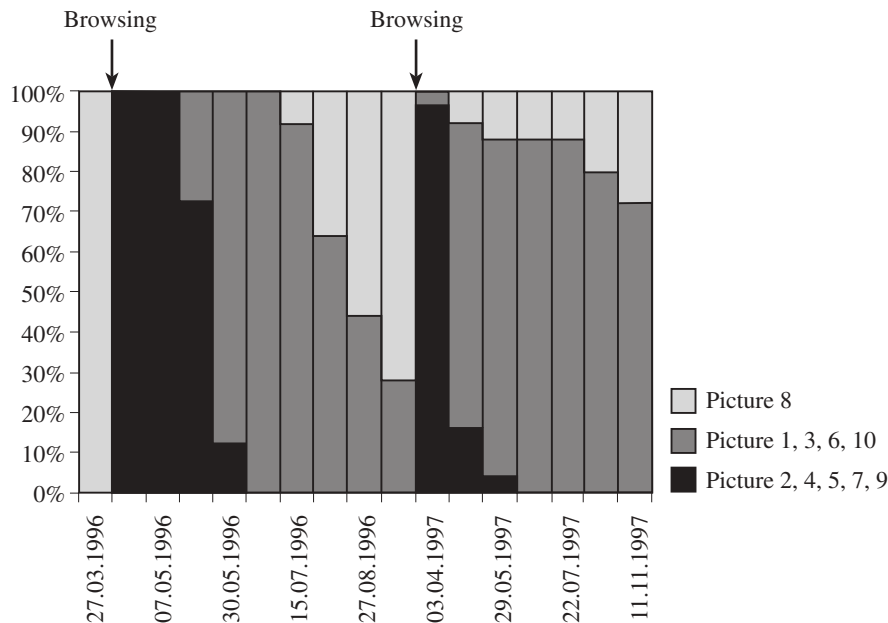


Figure 5. Regeneration of spruce in the nursery after treatment 4 (browsed according to the NFI1: browsing pattern 2, 4, 5, 7, 9).

The change of the browsing pattern, which represented browsed plants according to the first NFI (browsing pattern 2, 4, 5, 7, 9), to ones that did not count as browsed (browsing pattern 1, 3, 6, 8, 10) only happened during the growing season. The survey method in the first NFI found a large number of browsed plants in the spring and a small number in the fall. The results of the browsing survey according to the first NFI methods were, to a large extent, dependent upon the date the survey was taken and was, therefore, applicable for large-scale inventories in a limited capacity.

The same situation was found for the plants that were studied three times a year within the scope of the field experiment (Figure 6). The first NFI method discovered a high proportion of browsed plants in the spring, and only a small portion in the fall. For assessments before the beginning of the growing season, the results of the first NFI method approached the ones of the annual browsing (browsing rate). Nevertheless, the results of the first NFI methods were a bit smaller, since the summer browsing was not considered.

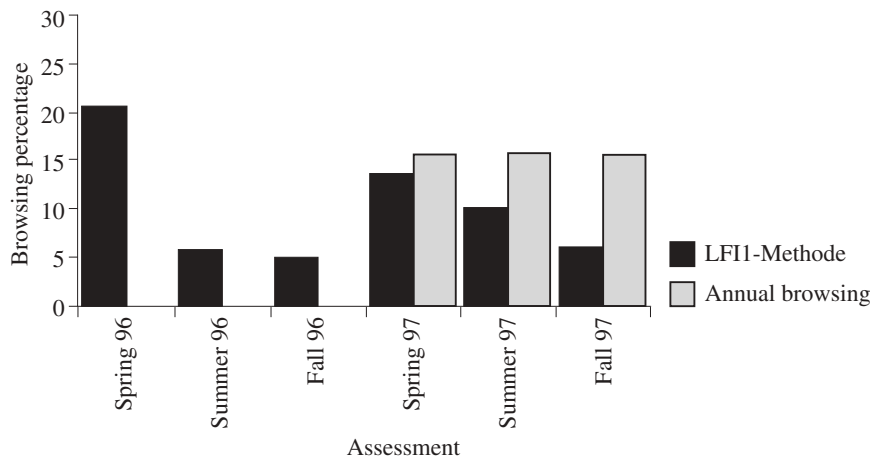


Figure 6. Annual dependency of the browsing percentage assessed with the NFI1 method. Example: Spruce in the field experiment.

### 2.5.5.2 The NFI2 Method

With the browsing evaluation in the second NFI, it was possible to dampen the effects of the annual browsing percentage fluctuations considerably. The result of a browsing survey with the second NFI method was, therefore, less dependent on the date of the survey than in the first NFI (Figure 7).

The NFI2 method did not allow for more precise information regarding the degree of the annual browsing, since backdating did not refer to a constant number of years. The browsing determined with the second NFI method amounted to approximately twice the annual browsing over all tree species. However, depending on the tree species and site, the results differed from this considerably, as was observed with the example of the spruce.

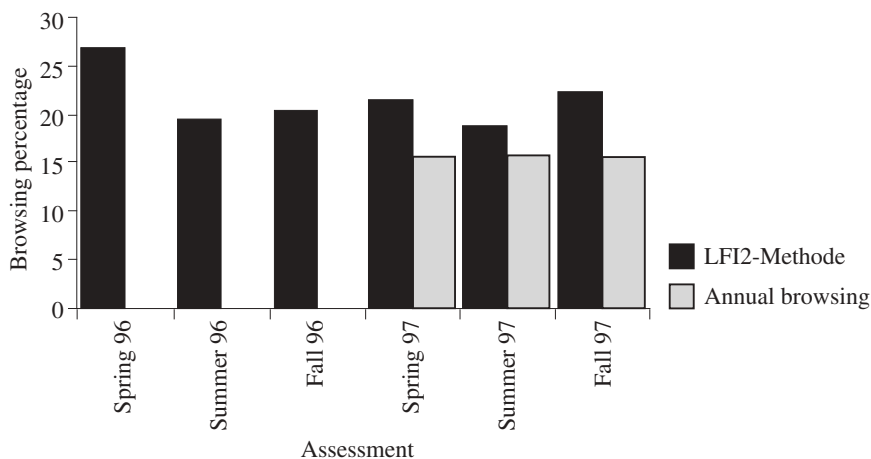


Figure 7. Comparison of the browsing percentages assessed with the NFI2 method with the annual browsing.

Example: Spruce in the field experiment

### 2.5.6 Conclusions

- The additional analysis confirmed that the methods of evaluating the browsing in the second NFI depended far less on the date of the survey (season). A modification to the second NFI method will be able to not only eliminate the seasonal fluctuations, but to approximate the annual browsing as well.

- Due to its robustness, the method of the browsing evaluation in the second NFI is suited for large-scale monitoring of changes in the browsing rate.
- The browsing that was reported in the second NFI was consistently higher than the annual browsing. For an exact determination of the browsing rate more measurements per year would certainly be needed.
- For the evaluation of the browsing situation, it was not only important to know the browsing incident, but also the reaction potential of the plants. The growth and reaction potential of a plant depended substantially on the plant species as well as the site (climate, altitudinal vegetation zones).

### 2.5.7 Literature

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