3.7 Recreational Function

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3.7.1 Introduction

The significance of the forest as recreational area has increased constantly over the last few decades. According to estimates by Jacsman, approximately 220,000–250,000 people visit the Swiss forest at the same time during a nice Sunday afternoon (JACSMAN 1991). Even the Swiss montane population rates the importance of the recreational function of the forest as high as the protection function (ZIMMERMANN *et al.* 1996). Consequently, the forest is, according to the Federal Law of Forests, supposed to fulfill in a sustainable manner, apart from the production and protection function, non-profit functions, such as recreation (Chapter 3.6). The most intense discussions during the process of the cantonal forestry legislation very often touch upon the question of recreational use. In summation, it can be said that recreation in the forest is very important in Switzerland.

Similar to the forest function definition in Chapter 3.6, which has become more accepted as of late (BUWAL, Bundesamt für Umwelt Wald und Landschaft 1996), it is possible for recreational functions in the forest to distinguish between the recreational demands which society places on the forest (demand) and the recreational effects of the forest (supply/opportunity).

Models of the second NFI

The current knowledge, with respect to recreation in the forest, comes mostly from case studies that cannot be applied to all of Switzerland without problems. The focus of these studies "recreation in the forest" are mainly directed towards the recreation in areas of urban agglomeration, recreational demand, visitor frequencies, recreational land-use pressure, external yield, etc. (for example see JACSMAN 1998; NIELSEN 1992; SCHELBERT *et al.* 1988). Therefore, it was not possible to go back to already existing models in order to come up with information about recreation in forests on a national level.

Even though in the second NFI a survey of forest functions could not be realized due to methodological and financial reasons, some new data with respect to the recreational use of the forest was gathered. In addition, some simple models for recreational demands and forest effects were developed. Due to this, information for the entire country of Switzerland is available for forest policy discussions and decisions on a national level. The models presented here have, however, **pilot character**. For example, the model of recreational demands is limited to **short-term (local) recreation** (Chapter 3.7.2). All models shall be extended and refined during future NFI surveys. This is, however, only possible when more fundamental knowledge about the multiple effect factors and mechanisms of recreation in the forest is available.

3.7.2 Recreational Demand of the Society

Recreation in the forest is, in essence, part of the landscape and outdoor recreation (JACSMAN 1990). Often they cannot be discussed separately. The forest is especially important for sports and recreation in densely populated areas and tourist regions. In urban agglomerations, with the absence of alternatives, outdoor recreation is often entirely concentrated in the forest. The numerically most important group seeking recreation in the forest consists of hikers and walkers (BURKHALTER and SCHADER 1994; JACSMAN 1990).

The analyses of the second NFI are directed entirely toward **local recreation** for many reasons: First, the largest demand for recreation consists in daily recreation and, therefore, most likely conflicts with the interest of other forest functions, such as nature protection and timber production. Second, data and models to quantify other forms of recreation, such as excursion recreation did not exist in the second NFI. Local recreation in this context is defined as outdoor recreation in local areas (JACSMAN 1994). For this reason, residential towns as well as tourist towns that have a considerable number of guest rooms, are taken into account.

3.7.2.1 NFI2 Models for Recreational Demand

Theoretical Approach

Several different approaches and methods exist in order to quantify the demand of forest recreation. According to JACSMAN (1994), land-use planners define the term *recreational demand* as the number of humans that are/would like to be involved in outdoor recreation. Frequently, the current "number of visitors" is used that is established by large-scale field surveys. Such observations are conclusive indicators for recreational demand only in accessible forests. Other methods must be used to answer the question whether forests in regions with high demands also have a well developed road system and are therefore accessible. Jacsman, for example, estimated with the help of models the regional mean use intensity of forest recreation in Switzerland (JACSMAN 1990). The true recreational demands at the national level are, however, not known. As mentioned above, the necessary requirements were missing in the second NFI in order to further develop and employ the complex models of JACSMAN (1994) for sample surveys. Thus, the demand for local recreation was estimated in the second NFI with new, but simple models.

The demand for local recreation in the forest depends on several factors (JACSMAN 1994): For one, it depends on the number of inhabitants, weekenders, vacationers, and the individual type of recreation or recreational activity (hiking, sports) performed. It also depends on the size of the town, distance to the town, forest density, and distribution of the forest. The landscape-oriented recreation in urban areas and near villages (local recreation) is regarded as a year-round phenomenon and is mostly independent of the season. The number of motorized vehicles per capita, the climate, and weather are less important factors for local recreation than for other forms of outdoor recreation. But on a larger scale, no facts are available about the types of recreation. Thus, and since it is not known how the size and distribution of forests and settlements within Switzerland influence the recreational demand, the NFI2 models derive the recreational demand simply by using the number of inhabitants and long-term visitors.

How can local recreation be defined with respect to settlement proximity? According to JACSMAN (1990), the average annual duration of one stay in the outdoors was 45–75 minutes for local inhabitants; 70–110 minutes for long-term visitors (tourists); and 100–140 minutes for short-term day visitors (trippers).

The NFI model describing this recreational demand is based on the assumption that one walk, including return, does not normally exceed two hours (Jacsman, oral communication). Depending on the pace, this results in an estimated maximum distance of approximately two times 3–5 km (which equals 6–10 km in total). Depending on the route configuration (route curvature) and slope of the terrain, the actual covered horizontal distance can be significantly shorter.

Based on studies conducted in the test region of Zurich and Davos, it is reasonable to assume a horizontal activity radius of 2–3 km. Sometimes a chain of mountains limit, in reality, recreational use and thereby reduce the activity radius. Due to this, the lower limit of the relevant activity radius (i.e., 2 km) was used in the model. Based on these considerations, the recreational demand is defined as follows:

The recreational demand on the NFI sample plot is proportional to the population and tourism density within the proximity of 2.0 km.

The population density (E2) and household densities (W2, Wt2, Wd2) (see below) that were used for the derivation of the recreational demand were calculated at the WSL with the help of a geographic information system (ARC/INFO). The quantities correspond to the sum of all hectare values of the information grids GEOSTAT (BFS 1994b) within the proximity of two kilometers of each NFI sample plot (i.e., an area of 12.6 km^2).

Model Development

A measure for the population and tourism density is the number of inhabitants and visitors per hectare. The number of inhabitants was available from the 1990 population census in a hectare grid of the Swiss Federal Statistical Office (BFS). The number of visitors could theoretically be derived from the number of occupied beds according to the tourist industry (hotels, bed and

breakfast places, holiday homes, youth hostels, campsites). As a simplification, only the number of available beds in hotels was used as an indicator, unless there were no other data obtainable. These data for hotel and health resort enterprises were, for 1995, only available for each municipality in printed form (BFS 1994a) and were, therefore, only used for the model development in the test regions of Davos and Zurich. In both of these regions the probable recreation demand was oculary estimated on a total of 51 NFI sample plots in the field. Apart from the actual local recreation, "traces" of recreational activities were included as well. It is important to note that especially in Davos these traces are partially the result of excursion tourism.

Categories of recreational demands (ocular estimation):
1 None
2 Probably low
3 Average
(walkers or traces showing walkers/hikers used an area: rubbish, beaten path, campfire)
4 Considerable
5 Very high

It is a fair assumption that inhabitants and (long-term) visitors are different with respect to their demand for local recreation in the forest. But how do visitors or their indicators, such as the "number of beds", need to be weighted? The demand model EN1 gives equal weight to the number of inhabitants (E2) and to the standardized number of beds (B). This resulted in a similar coefficient of determination (R^2) of 0.57 and 0.51 for both test regions. However, in respect to the ocular estimation, the model EN1 did not result in supraregional comparable values (Figure 1). Thus, several models with different weights were tested. The function EN showed the best comparability of the regional model values and had correspondingly the highest correlation between the ocular assessment and the mixed model (total) for both regions combined (Figure 2):

$$\begin{aligned} B &= BG/EG*E2 \\ EN1 &= BG/EG*E2 + E2 \\ EN &= 10*BG/EG*E2 + E2 \end{aligned} \quad (1)$$

EN: Recreational demand
BG: Total number of available beds in hotels in the corresponding municipalities (1995)
EG: Total number of inhabitants in the corresponding municipalities (1990)
E2: Total number of inhabitants in a radius of 2 km (1990)

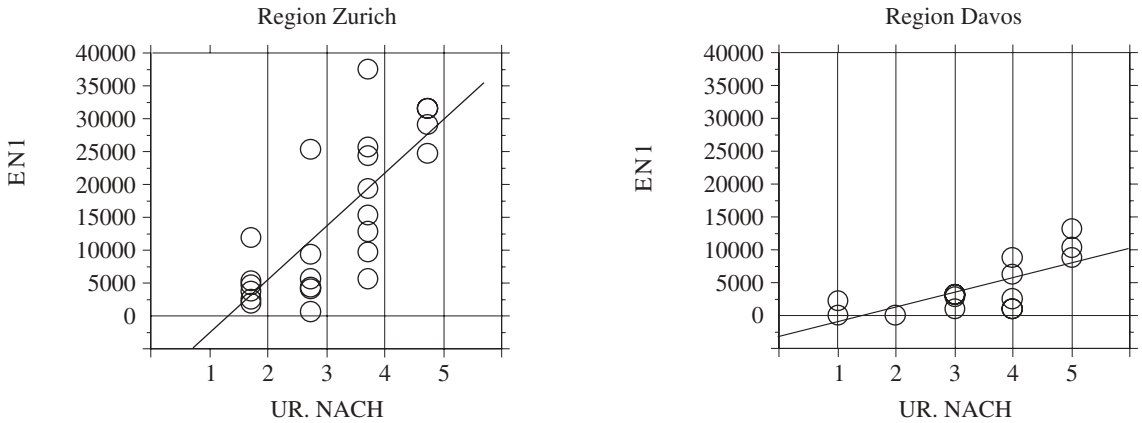

Figure 1. Comparing the model values (EN1) with the expert's assessment (UR.NACH) for the recreational demand of accessible forests in the test regions of Zurich and Davos. EN1 = BG/EG*E2 + E2 BG: Total number of available hotel beds in the municipality. EG: Number of inhabitants in the municipality (1990). E2: Number of inhabitants within a radius of 2 km (1990).

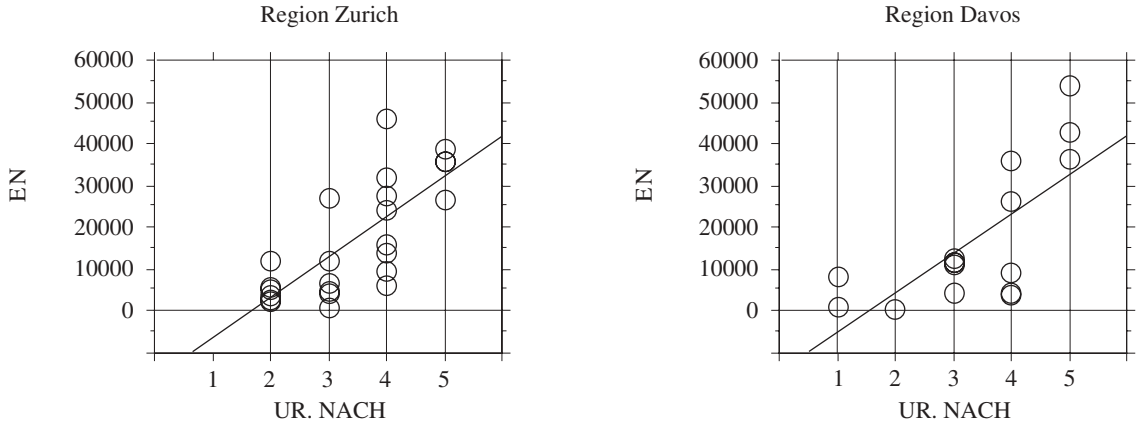

Figure 2. Comparing the model values (EN) with the expert's assessment (UR.NACH) for the recreational demand of accessible forests in the test regions of Zurich and Davos. EN = 10*BG/EG*E2 + E2 BG: Total number of available hotel beds in the municipality. EG: Number of inhabitants in the municipality (1990). E2: Number of inhabitants within a radius of 2 km (1990).

Model ERHOLNA

Since the number of hotel beds was only available for each municipality and not in digital form, the tourism density on the national level had to be estimated in the second NFI with the help of an auxiliary variable. The "number of temporarily occupied or unoccupied households per hectare", calculated on the basis of the population census 1990 (BFS 1994b), was determined in the NFI to be a suitable indicator for the beds in hotels. The true number of available beds per municipality (BG) was well reflected by the following model MBG (R^2=0.88) in the test area:

MBG = (1,33 * WG * Wt2) / W2

MBG: Number of available beds in hotels in the municipalities according to the model
WG: Total number of households in the corresponding municipalities (1990)
Wt2: Number of temporarily occupied or unoccupied households within a radius of 2 km (1990)
W2: Total number of households within a radius of 2 km (1990)

The appropriate indicator for inhabitants is the "number of permanently occupied households per hectare" according to the 1990 population census. The linear regression between the household density and the population density had a very high coefficient of determination (R^2) of 0.99. This shows that there is a close relationship between inhabitants and permanently occupied households, or between the number of beds in hotels and the temporarily occupied households (see above). Therefore, as an alternative to the model EN (1), a simple model based solely on the number of households, was developed for potential recreational demand. In the first approach, two types of households (Wd2, Wt2) were added up with equal weight. Compared with the ocular assessment of recreational demands, it was obvious that for the same ocular values the number of households was three times lower in the tourist region of Davos than in the highly populated region of Zurich. As a consequence, several models were tested, which gave a higher weight to the temporarily occupied and unoccupied households (indicator for vacation homes). The highest coefficient of determination and a good interregional agreement between the ocular assessed recreation demands and the number of households was achieved with a model that attached a five-times higher weight to the temporarily occupied and unoccupied households than to the occupied households (Figure 3):

ERHOLNA = Wd2 + 5*Wt2 (2)

ERHOLNA: Recreational demands according to the model NFI2
Wd2: Number of permanently occupied households within a radius of 2 km (1990)
Wt2: Number of temporarily occupied or unoccupied households within a radius of 2 km (1990)

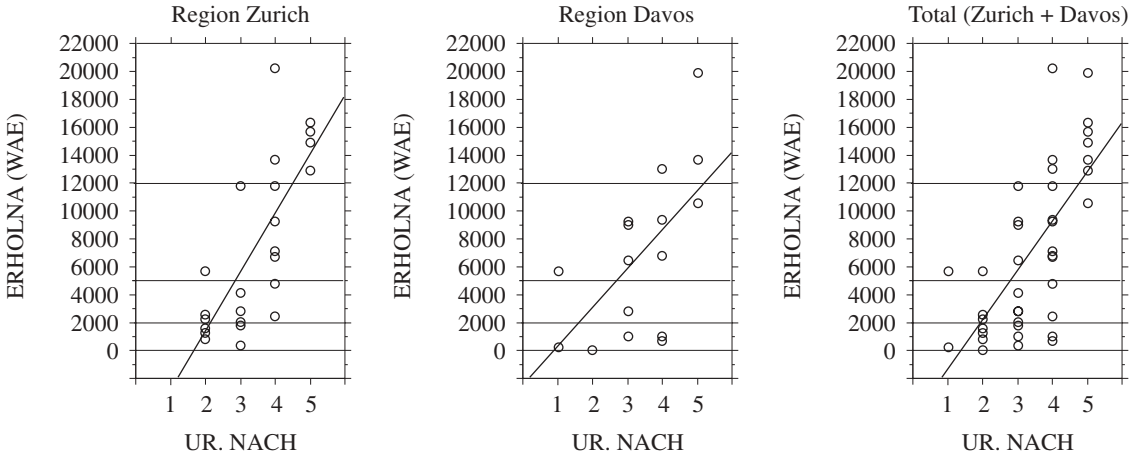

Figure 3. Recreational demand: Comparing the model values (ERHOLNA) with the expert's assessment (UR.NACH) for the recreational demand of accessible forests in the test regions of Zurich (R^2=0.56), Davos (R^2=0.37), and total (R^2=0.47). WAE: Household equivalents.

Validation and Interpretation

The calculated quantities of the potential demand for recreation are expressed in household equivalents (WAE). The values range in the NFI2-grid between 0 and 42,521 WAE. Based on the ocular assessments from the test regions in 1995, and with additional ocular assessments in the year 1996, the model quantities can be interpreted as follows (see also Figure 3):

Up to 4 WAE:	=	No recreational demand
5 to 1999 WAE:	=	Low recreational demand
2000 to 4999 WAE:	=	Moderate recreational demand
5000 to 11999 WAE:	=	High recreational demand
Over 12000 WAE:	=	Very high recreational demand

The scale is not valid everywhere, especially since regional differences in the behavior of the local population (city/country) and the visitors (summer/winter tourism) were not considered. The main intent was not only to quantify forests in areas which have high or very high actual recreational demand, but to quantify those forests in areas that have low or no recreational demand as well.

The recreational demand model was verified in regions with very high and very low values for recreational demand (region Montana-Sierre-Val d'Anniviers (VS), region Nyon-Marchairux-Vallée de Joux-Grand Risoux (VD) and region Zurich-Mutschellen (ZH/AG). It could be seen that no/low and high/very high recreational demands were well assessed. In forests near agglomeration areas, where the model indicated "moderate" recreational demand, traces with significant recreational demands were found. As a consequence, this class could be interpreted as "considerable recreational demand" in the Jura, Plateau, and Pre-alps where recreational demand is mainly the result of the local inhabitants. The "moderate recreational demand" outcome for the Alps resulted mainly from using the model for tourism density.

3.7.3 Recreational Effects of the Forest

In the context of outdoor recreation, JACSMAN (1994) refers to the term "recreation opportunities" and makes a distinction between the quantitative opportunities (area, capacity) and the qualitative opportunities (recreational suitability). The recreational suitability is comprised of five components: environmental qualities (natural hazards, emissions), event potentials (beauty, naturalness, diversity, uniqueness), suitability for activities (type and intensity of possible recreational use), equipment (facilities), and accessibility (distance or travel time). In the NFI, similar to the terminology of other forest functions, the term *recreation effect* is used in place of *recreational suitability* or *recreational opportunities*.

To what extent a forest stand is really suitable for recreational use is thus determined by a multitude of criteria. After looking through the German-speaking literature, with respect to the term *recreational suitability* (Arbeitsgruppe Landespflege 1982; BENTS 1974; GUNDERMANN 1972; KIEMSTEDT 1972; RUPPERT 1971; SCAMONI and HOFMANN 1969; WULLSCHLEGER 1982), several effect factors can be named. Based on the weighting and mention by the individual authors, the effect factors can be grouped according to their importance as follows:

Very important:	Conifer proportion (mixture proportion), ligneous species diversity, stand structure (layering), stages of development (age classes), outer forest edge, inner forest edge, acoustical disturbances, smoke and dust emission, large bodies of water and shore
Important:	Variety of forms (shaft, crown, standing dead trees), naturalness of the stocking, tending status and type of utilization, accessibility of the stand, road density, distance to the next road, position of the forest area, optical disturbances
Less important	Crown closure, composition of the ground vegetation, visual range in the forest, overview of the landscape, regional forest proportion, local climate, form of the surface (slope, relief), recreational facilities, places of interest, visitor density (population pressure), color diversity (shaft, crown, ground vegetation, i.e., herbaceous layer)

The actual evaluation of the recreational opportunity requires weighting and the combination of effect factors in a model. From the above mentioned literature several approaches to evaluate the forest effects are known. The validity of most of these models is limited to certain areas. Furthermore, the models are partially contradictory and cannot be applied to all of Switzerland.

The sample survey of the second NFI provides information about the forest stands. That is, it provides information for a relatively small, homogeneous reference area. An appropriate method to evaluate the recreational suitability of forest stands was developed by SCAMONI and HOFMANN (1969). The employment of these models in the second NFI was not possible for two reasons: A large part of the required criteria, such as public transportation, parking space, zoological gardens, restaurants, air-hygiene, and nuisance factors could not be assessed in the second NFI. Moreover, even today in Switzerland current studies are missing about the relevancy of criteria, such as tree species diversity, conifer proportions, stand structures, sites (aspect, slope, relief, climate), acoustical and optical disturbances as well as others.

The recreational effect of the forest was in the second NFI evaluated therefore based on the parameters "**accessibility**", "**infrastructure of recreational use**", and "**natural characteristics**" of the forest stands. These are aspects that can be directly influenced by a forest manager and forest owner. Thus, they are of central importance as indicators for sustainable forest management.

3.7.3.1 Accessibility and Infrastructure

A basic requirement for recreational use, especially for local recreation, is **road accessibility**. During the second NFI, this accessibility was evaluated, based on the horizontal distance of the sample plot center to the next truck-accessible forest road (transportation distance), as well as on the length of the forest roads per hectare forest (density of the forest roads). The forest road network, which was relevant for the timber transport, was updated and digitized in the second NFI. As defined on a 1:25,000 national map, these are usually second to fourth class roads that have a minimum width of 2.5 meters and allow vehicles that have a load carrying capacity of 10 tons axle load. The calculations of the transportation distance were conducted with the GIS ARC/INFO (HÄGELI and ZINGGELER 1996). The transportation distance did not contain any information about roads and paths of the class 5 and 6 (tractor roads, skid trails, paths, hiking trails, and bikeways). For this reason, the occurrence of such roads (yes/no) were also assessed in the field on the 50 meters x 50 meters interpretation area (STIERLIN *et al.* 1994).

The term **infrastructure** refers here to facilities for local recreational use: benches, rubbish bins, permanent campfire areas, playgrounds, campsites, ski and chair lifts, ski slopes and cross

country trails, fitness trails, and others. Such facilities are indicators of a deliberate improvement in recreational opportunities by the forest owner, manager, or other institutions. If neither roads and trails, nor recreational facilities existed on the NFI interpretation area, the area was searched for the occurrence of other **traces** of recreational use: rubbish, wood carvings, trails that were not planned (human, horse), campfires, etc.

During the interpretation, NFI sample plots were considered directly accessible if they included special recreational facilities or trails, and/or if they were within 30 meters of a forest road. Forests were considered "not developed" if the transportation distance was over 200 meters, which corresponds with a mean road distance of more than 400 meters.

Categories for accessibility/infrastructure:

Good:	Distance to the next forest road ≤30 meters and/or recreational facility existing
Moderate:	Distance to the next forest road 31–100 meters
Poor:	Distance to the next forest road 101–200 meters
Non-existent:	Distance to the next forest road >200 meters

Based on the attribute accessibility/infrastructure, as well as the model for recreational demand (ERHOLNA, Equation 2), the current importance of the forest with regard to local recreation is determined according to Table 1.

Table 1. Model for the current importance of the forest to the local recreation, that is based on recreational demand (ERHOLNA in household equivalents (WAE)) and accessibility/infrastructure.

Recreational demand		Accessibility/infrastructure			
		Good	Moderate	Poor	Non-existent
	ERHOLNA				
None	0–4				
Low	5–1999				
Medium	2000–4999				
High	5000–11999				
Very high	over 12000				

Current importance to the local recreation

	High (typical local recreation forest)
	Medium
	Low/none

3.7.3.2 Natural Characteristics

The suitability of a forest for the purpose of recreation depends, among other things, on its composition and structure, the so-called natural characteristics. The natural characteristics are determined by site conditions and by anthropogenic influences, especially forest management. Nature lovers and forest walkers very often have high demands in regard to the aesthetics and diversity of the forest appearance. The evaluation of the forest appearance is, however, always subjective. Depending on the season, region, and the individual preference, the demands are so diverse that in the literature, and based on personal experience in the forest, only a relatively small consensus could be determined for the natural characteristics.

Despite this realization and despite lack of funds, an attempt was made to develop an initial model for the natural characteristics with **pilot characteristics**, similar to the model used for the protection forest (Chapter 3.6) and nature protection (Chapter 3.8). The current level of knowledge and the derivations of the models do not allow for an absolute judgement or for a representative population judgement. However, certain relative statements about regional differences and temporal developments are possible.

For the development of the NFI models for the natural characteristics, the relevant NFI parameters were initially evaluated in 1995, and the attributes were subjectively weighted by an intern based on the literature (Table 2). Subsequently, tree, stand, and area attributes were assessed and a subjective overall assessment of the natural characteristics was conducted on 51 NFI sample plots in the test regions of Zurich and Davos.

Table 2. Parameter and weights of the attributes in the NFI model for natural characteristics.

Parameter	Abbreviated name	Attribute	Weight
Stage of development	EST	Young growth / thicket	1
		Pole wood	2
		Young timber	2.5
		Medium timber	3
		Old timber	4
		Mixed	5
Stand structure	STRUK	One-layered	1
		Multi-layered	2
		Multistorey	3
		Cluster structure	2
Coverage of ground vegetation	BODVEGDG	Snow cover	1
		Less than 1%	1
		1–9%	1
		10–25%	3
		26–50%	4
		51–75%	3
		76–100%	2
Coverage of shrub layer	STRADG	Less than 1%	1
		1–9%	1
		10–25%	3
		26–50%	4
		51–75%	3
		76–100%	1
Surrounding of forest edge	WRUMG	Settlement and transportation routes	0
		Arable land, artificial meadow, vines	1
		Fertile meadow	2
		Fertile meadow with trees/shrubs	3
		Pasture	1.5
		Grazing woodland, stocked pasture	3
		Tall forbs	1
		Dry meadow	3.5
		Wetland	2
		Bodies of water: lake, river	5
		Rock, scree, wasteland	1.5
Type of gap	LUECKEN	No larger gaps in the stand	0
		Cutover or windfall areas	1
		Forest meadow without woody plants	4
		Forest meadow with woody plants	3
		Blocks, scree area	2
		Erosion and landslide areas	0
		Rock areas	3
		Avalanche rides, forest aisle	2
Basal area proportion of the recreation species (birch, sessile and common oak, Scotch pine, mountain pine, Swiss stone pine, larch, and cherry tree)	ERHARTEN	0%	0
		1–10%	2
		11–50%	4
		51–100%	5

A detailed analysis (stepwise regression) of these field data indicated that the subjective overall assessments by the intern is mainly explained by the parameters “stage of development”, “crown closure of the ground vegetation (herbaceous layer)”, and “stand structure”. The remaining parameters were not significantly correlated with the subjective assessment, which was partially due to their rare occurrence and the relatively small data set.

The parameter “coniferous proportion”, as well as the “ligneous species diversity”, proved to be not suitable for a model that was supposed to be valid in lower as well as in higher elevations. Instead, the occurrence of individual tree species that have particular aesthetic appeal, such as birch, sessile and common oak, sweet cherry, Scotch pine (*Pinus sylvestris*), mountain pine (*Pinus mugo*), Swiss stone pine (*Pinus cembra*), and larch were introduced afterwards into the model as a new criterion “recreational species”.

The weights of the seven parameters in the overall model “natural characteristics” (ERHNATU3) were determined based on the correlation with the subjective assessment. Most of the parameters for the natural characteristics were first introduced in the second NFI (STIERLIN *et al.* 1994). For the comparison with the first NFI, a strongly reduced model (ERHNATU1) with the two most relevant parameters “stages of development” and “stand structure” was derived:

ERHNATU1 = EST + STRUK
ERHNATU3 = 4*EST + 2*STRUK + BODVEGDG + STRADG + WRUMG + LUECKEN + ERHARTEN
(For variables see Table 2)

The values for natural characteristics can range for the models ERHNATU1 and ERHNATU3 between 2 and 7, as well as 8 and 42, respectively. The following thresholds were determined for the interpretation of the model values based on field verifications:

Natural characteristics	ERHNATU1	ERHNATU3
Low	up to 2.5	up to 12
Tends to be low	2.6–4.0	13–20
Tends to be high	4.1–5.5	21–28
High	above 5.5	above 28

The result volume publication of the second NFI used the following classification:

Natural characteristics	ERHNATU1	ERHNATU3
Low	up to 3.0	up to 15
Medium	3.1–5.0	16–25
High	above 5.0	above 25

The model ERHNATU3 was standardized and verified in the regions of Davos and Zurich. In addition, plausibility tests were conducted in the same areas as for the demand model. These tests indicated that the natural characteristics which were determined in the NFI-area, with a maximum dimension of 50 x 50 meters, were plausible for large, homogeneous stands. For small stands and especially for a mosaic of stands, the overall aspects of natural characteristics are often not adequately reflected.

3.7.4 Discussion and Outlook

One of the tasks of the NFI is the comprehensive control of sustainability at the national level. Suitable indicators for the recreational functions are for the most part still missing today. An important goal for the future is to develop these indicators, and also discover ones for excursion recreation, which was not studied here.

Appropriate survey methods must be developed and their applicability to sample inventories should be tested. The models presented here are only the first step. A new efficient method to assess additional factors, such as the number of visitors, the type of recreation, the infrastructure (parking space, gastronomic facilities, places of interest, marked hiking trails) or nuisance

factors (noise, etc.) could be to conduct enquiries at the local forest service. The extended employment of the GIS for the analysis of the information grid and digital maps also should be checked.

Natural Characteristics

The importance and significance of the natural characteristics of a stand for recreation in the forest is not clarified. The fundamental questions, whether and how the forest visitor perceives (at all) the natural characteristics of a forest stand, and whether these characteristics are important and influence their selection in using a certain area of the forest remain unanswered.

It is possible that other criteria, such as accessibility, trail and road systems, sports trails, peacefulness, cafes/restaurants along hiking trails, and missing recreational opportunity alternatives are much more important and that the natural characteristics of a stand plays a minor role.

Open questions that are interesting in this context are:
- Which factors influence a forest visitor?
- Are the natural characteristics of a stand relevant for/during a forest visit?
- Which visitor groups notice the natural characteristics of the stand?
- Which aspects of the natural characteristics are preferred and which are avoided (indicators)?

The NFI inventory design was optimized in respect to the state and changes of timber volume and forest area. The data assessment was conducted from an aerial photograph or on the ground in the sample plots with the maximum dimension of 50x 50 meters. This leads to certain **methodological problems** for the assessment of the recreational effects of the forest.
- For the recreation in the forest, individual stands with their natural characteristics are not so important. It is often the stand mosaic, that is to say, the contrast and diversity (e.g., light/dark, small/large, broadleaf/coniferous forest, dense/loose), as well as the sequence of individual stands, that makes a forest with its natural characteristics attractive for a forest visitor.
- Contrary to the target parameter, timber volume and forest area that can be objectively measured and interpreted (continuous quantities), the evaluation of the natural characteristics of the stands are always subjective and depend on regional preferences of the forest visitors.

Based on the current open questions as to the significance of the natural characteristics and the above mentioned methodological problems, two directions can be followed with future NFI surveys in order to better quantify recreational effects:
1. Characterization of the ideal recreation forest can be better understood by questioning the population (systematic sample or regional case studies) with respect to key criteria, effect factors, and indicators, as well as their relevant evaluation area.
2. Development of suitable survey methods, especially for the assessment of the important stand mosaic and spatial sequence, as well as development of new models for natural characteristics and for recreational value overall. Standardizing and verifying the models using uninfluenced lay people.

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3.7.5 Literature

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