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The Benefits of Local Forest Recreation in Austria and Its Dependence on Naturalness and Quietude

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Abstract: The benefits of local recreation in the State-owned forests in Austria (i.e., about 15% of all Austrian forests) are ascertained in this paper. A representative survey of households dealt with their local recreation, perceptions of and disturbances in forests. Total annual benefits of local recreation activities in State-owned forests, such as walking, hiking, cycling and wildlife observation, amount to about EUR 500 per person. Based on the respondents' valuation of the degree of naturalness and quietude, as well as the options of forest management, the current management increases recreation benefits by EUR 13 per person through increased naturalness, and EUR 1.30 per person and year through increased quietude. Emphasis was placed on the benefits of the current management regime of multifunctional forestry compared to the benefits of a baseline scenario that was drafted specifically for this study, assuming higher levels of lumbering up to the limits allowed by existing nature conservation and forestry laws. The results suggest that forest management has a higher impact on recreational benefits through the naturalness of forests than through reducing artificial noise. A more sustainable forest management could further increase the benefits people derive from both naturalness and lower levels of artificial noise.

Keywords: Local recreation; travel distance; recreation activities; forests; naturalness of forests; quietude

1. Introduction

Forests close to residential areas offer natural environments, clean air and quietude. They are, therefore, essential for local recreation. The value of recreation for visitors depends on a wide range of attributes of the forest. These are, on the one hand, the degree of accessibility (distance to the place of residence), infrastructure for visitors (e.g., trails, picnic areas) and the extent to which only natural sounds can be heard. On the other hand, the naturalness of the forest and biodiversity are evaluated, for instance, according to the diversity of tree species of all ages, the density of the forest, and its appearance (see reviews e.g., [1–3]). Edwards et al. [4] point out that the age of the forest (i.e., the current stage of development) as well as the (perceived) degree of naturalness that can be judged by the intensity of forestry and conservation efforts contribute most of all to recreation benefits. Forests and other natural environments are also of significant importance for human health and well-being (see e.g., [5–7]).

Natural forest environments are regarded also as green infrastructures for recreation, which is one of the most important cultural ecosystem services. It has been defined as "direct, in-situ and outdoor interactions with living systems that depend on presence in the environmental setting" ([8], see also [9,10]). This definition of cultural ecosystem services, concerning recreation, acknowledges the significance

of environmental and ecological resources to meet these human needs. Recreation is one of the key ecosystem services of forests that are close to residential areas (e.g., [11]). In this paper, the recreation function of forests is understood as the potential of forests to provide recreation benefits as an ecosystem service (see [12]), the latter being the actual use of forests for recreation purposes (recreation services). By "local recreation", the authors of this paper refer to the recreation activities in forests that are close to residential areas and thus accessible to local residents for daily or weekend activities (cf. [13]; for details, see Section 3). Therefore, this paper does not take into consideration longer overnight stays and vacations connected with forests (cf. [14]). Local recreation is thus defined empirically in regard to the distance from the visitor's residence to the forest of up to 5 km (see Section 3).

In Austria, forests cover about 50% of the land. Therefore, forest ecosystems may have a significant role in local recreation. Owned by the Republic of Austria, the Austrian Federal Forests (*Österreichische Bundesforste, ÖBf*) manage forests and other land, such as high-alpine areas and lakes on about 15% of Austrian land. Federal law [15] requires the ÖBf, as a public company, to manage the public land with regard to the principles of sustainable forest management, and to earn profits for the Central Government's budget. The ÖBf conserve and manage diverse ecosystem services within the framework of multifunctional forestry. This framework accounts, among others, for the provision of recreation infrastructure (e.g., hiking trails, mountain bike routes, nature trails). Significant shares of ÖBf land are also protected under regional, national or international (especially European) law (e.g., Natura 2000; national parks according to category II of the IUCN Management Categories; see [16]). Furthermore, ÖBf forests protect residential and commercial areas, and infrastructures in Alpine areas [17].

In this context, this paper examines which local recreation activities take place in areas of the Austrian Federal Forests (ÖBf), assesses the value of the benefits of local recreation, and ascertains how important the natural conditions (naturalness) and quietude are for recreationists.

A representative survey of Austrian households carried out in 2015 provides the empirical basis for answering these research questions. Furthermore, the effects of the current management framework of the ÖBf ("multifunctional forestry") compared with a (hypothetical) baseline scenario in which the lumbering of timber is increased up to the legal limits given by the Austrian Forest Act are evaluated. As environmental valuation specifically ascertains the value of the marginal change of environmental quality, it is important to describe the baseline and the (current) management policies carefully. Costanza et al. [18] have recently pointed out that an integrated modeling approach, including different scenarios, bundles of ecosystem services, and trade-offs, should be used.

This paper thus concentrates on the prospects of forest management to enhance the benefits of local recreation in two fields. First of all, forest management can improve the natural state of forests (degree of naturalness) which may foster the benefits of local recreation [19]. Secondly, quietude and natural sounds are an important part of the recreation experience. While noise pollution is pervasive even in remote, protected areas [20], the options of forest management and planning to reduce noise pollution are limited (see Section 5). We define quietude as a situation in which visitors can hear only natural sounds. Our study highlights the large gross benefits of local recreation provided by forests, which are in the range of values provided in international literature (see Section 6). However, the options of forest management to improve these benefits are limited, especially concerning quietude.

2. Materials and Methods

2.1. The Survey Instrument and its Structure

In order to account for the aims of this paper raised in Section 1, a nationwide survey was designed and implemented on Austrian households. Besides other topics [21], the questionnaire focused on local recreation activities, and the preferences of households with regard to forest management (see the Appendix A for the key questions of the survey). The questionnaire was drafted within a period of about six months, reviewed comprehensively by other experts and scientists as well as by a focus group at the Institute of Spatial Planning (Vienna University of Technology). Furthermore, the market research institute commissioned with the fieldwork pretested a preliminary version before carrying out the main survey.

While the first part included general questions regarding forestry and the Austrian Federal Forests (ÖBf), the second part contained questions on how the respondents would assess the degree of naturalness of forests in their vicinity. In Figure 1, pictures can be seen that describe several kinds of forests in regard to the respective degree of naturalness of each. These pictures and descriptions were used to assess the naturalness of forests closest to the respondents' residences (cf. [21–24]).

Examples of Forests (as Presented in the Survey to the Respondents)	***Ecological State of the Forests***
	*Natural forests*: Old-growth forests without management and forestry use and a high degree of naturalness [a]
	*Good ecological status*: forests close to a natural state, with little management, tending, or use
	*Little naturalness*: Forests with sustainable forestry and limited clear-cuts
	*Artificial forest*: Intensive forestry and regular large-scale clear cuts

Figure 1. Pictures and descriptions used for presenting different degrees of naturalness of forests in the representative household survey. [a] As there are virtually no virgin forests left in Europe, we refer to the highest degree of naturalness of forests as "natural forests" and "old-growth forests" (see [25]). Source: Own survey and concept, 2015/2018 (pictures © Hanns Kirchmeir, reprinted by kind permission; [21]).

In order to facilitate a simplified assessment by respondents of the degree of naturalness, the four possible conditions of forests were labeled *natural forest* (e.g., old-growth forests and wilderness areas) to *artificial forest* (e.g., heavily modified forests with intensive forestry, monocultures and regular,

large-scale clear-cuts). The pictures were chosen to mirror forest conditions typical for Austria and were selected by ecological screening in order to visualize the appearance of forests according to the degree of naturalness (see [21] for more details).

Respondents were also asked about their local recreation activities (kind of activity, travel distance, perception of the degree of naturalness and quietude). The questionnaire also included two further parts. One was a choice experiment on different options and views in regard to recreation. The other part elicited the willingness to pay of respondents for several nature conservation programs on ÖBf land [21]. Both parts are not reported in this paper owing to lack of space. Further details are available upon request from the authors.

Finally, a wide range of debriefing questions on nature conservation policies and on the socioeconomic characteristics of respondents closed the questionnaire. The survey was implemented using random-quota sampling. The total number of respondents who completed the survey was $n = 1.501$. The sample was drawn from a certified household panel by the market research institute MarketAgent (Wiener Neustadt, Austria). The sample was stratified (with quotas) according to gender, age, education, income, and regional distribution (Austrian Federal Provinces). A total of 19,983 households were contacted by email; 2281 households responded (response rate 11.4%) of which 1501 were completed. Owing to age or local residence, 28 invitations were excluded, 322 interviews were not counted owing to already fulfilled socioeconomic quotas, and 430 interviews were terminated (termination rate 18.4%). The rather low response rate was owing to the length of the questionnaire. In addition, these statistics underestimate the response rate, since the email invitation to participate in the survey had to be accepted within a few days from the beginning of the survey. Some households that were invited could not answer the survey because the market research institute closed the web platform when the sample reached the target value of 1500 respondents. However, the results show that this response rate compromised neither the representativeness of the survey nor the plausibility of the results (see Section 6).

2.2. Individual Travel Demand Model

In order to calculate the recreation benefits (consumer surplus) people derive from visiting local forests, the linkages were modeled between the frequency of visits to the preferred local forest and the travel distance. An individual travel demand model was estimated by using a count-data regression. Testing showed that the negative binomial distribution fit the data best. As the model incorporates more than one number of visits per respondent, we clustered across the respondents (see Table 5 for details; cf. [26]; for applications in travel cost models see [27]). Explanatory variables include the recreational activities stated by each respondent in addition to the travel distance (km) and dummy variables, indicating naturalness and quietude of the visited forests.

A range of assumptions on travel costs is required to compute the recreation benefits (cf. [28,29]). For respondents who use a private car to travel to the forest visited, two components of travel costs are taken into account. The costs per km of using a car are taken from the official guidelines for benefit–cost analysis in the transport sector published by the Austrian Ministry of Transport [30]. Car costs amount to 0.42 EUR/km covering fuel and variable costs. Furthermore, RVS [30] assumes that the value (opportunity costs) of travel time for leisure purposes amounts to EUR 8 per hour. The opportunity cost of travel time has been studied by many scholars, e.g., in the field of infrastructure planning (e.g., [31,32]). More recently, Wheat and Batley [33] provide ranges and confidence intervals of the value of travel time in their comprehensive survey. The mean value of travel time of about GBP 0.13 per minute for non-work trips is very close to the opportunity cost of travel time of EUR 8 per hour as used in this paper.

For respondents traveling by public transport, it can be safely assumed that most respondents use their monthly or annual passes for the use of public transport. Therefore, a recreation activity does not cause major additional transportation costs. However, the value of travel time is still the above-mentioned amount of 8 EUR per hour. Finally, valuing travel costs and the time to walk or

cycle to the local forests is problematic since both modes may not cause economic costs but additional benefits. Walking or cycling to locations of recreation activities may already be a part of the whole recreation experience [34]. Many papers assume that travel costs consist of the opportunity cost of time only (e.g., [35], in regard to recreation activities). Furthermore, recent papers suggest that walking and cycling lead to benefits (utility) rather than costs. Krizek [36] provides evidence that cycling provides such positive utility. De Vos [37] supports this viewpoint since cyclists are among those who are most satisfied with their mode of transport. Zhu and Fan [38] draw similar conclusions for cycling compared to car use. With regard to the social costs (or benefits) of transport modes, Gössling et al. [39] find that cycling and walking provide substantial benefits in comparison with car use.

However, the current literature rarely treats the value of travel time for transport modes differently. For transport planning in Copenhagen, for example, the costs per km in regard to the time required when cycling and walking were about half of that which a car needed cf. [39]. Abrantes and Wardman [40] come to a similar conclusion by relating the opportunity costs of time of car use to those of other transport modes and discount the latter by about 35%.

Summing up, owing to the lack of quantitative data on different values for travel time, it is assumed that the opportunity costs of time are the same for all transport modes including walking and bicycling. Assumptions about travel costs usually influence consumer surplus in absolute terms, but the ranking of activities or alternatives does not change with different levels of travel costs (cf. [29,41]).

2.3. Design of a Baseline Management Scenario for Comparison to the Status Quo

The economic value of ecosystem services stems from the marginal change in environmental quality. Economic valuation does not focus on the stock values of ecosystems and their elements, such as single species and their ecological connections to each other, but on the flow values of ecosystem services and their marginal changes (e.g., [42–44]). Some valuation studies also try to calculate absolute numbers (e.g., total recreation benefits) especially for the case when marginal changes remain unclear, or management scenarios and options are not defined (for valuing ecosystem services in Switzerland, see e.g., [45]). The TEEB (The Economics of Ecosystems and Biodiversity) program reports a broad range of values for ecosystem services (see [46]). However, no indications in terms of the underlying marginal changes are given; this makes the use of TEEB results difficult for concrete policy and management designs. This paper specifically details recreation values for different types of activities, and explores the leeway of forest management to influence and increase (or reduce) these values.

In order to ascertain the recreation benefits that depend on forest management and are, in general, important cultural ecosystem services, all possible forest-related local recreation activities are accounted for by regarding all of the survey data on the frequency of these activities, travel costs and the distances that have been travelled. However, the money values, calculated by means of the travel cost method, account for the total value of flows of local recreation benefits in Austrian forests. To assess the economic benefits of the current management practices of the Austrian Federal Forests (ÖBf), it is of paramount importance to describe the current management framework (status quo) as well as the relevant, comparative scenario or baseline (cf. [18,47]).

The Austrian Federal Forests (ÖBf) label their current management framework as *multifunctional forestry* (cf. [48]). One may broadly consider this management practice as an attempt of a balanced mixture between sustainable forestry in large forest areas, while still preserving and managing protected areas in other parts of ÖBf land.

The hypothetical baseline scenario, formulated for this study, is drafted as a management scenario that waives this concept of *multifunctional forestry*. The main differences lie in a substantial increase in the lumbering of timber by about 18% and the reduction of protected areas by about 20%, both within the legal limits of the Austrian Forest Act and the existing nature conservation frameworks (see Table 1). These differences are the basis for describing and valuing the marginal change of recreation benefits brought about by the current management. Getzner et al. [17] exemplify this approach by protective forests in the context of gravitational hazards.

The formulation of this baseline scenario has its boundaries in the current legal frameworks of forestry, nature conservation, and the protection of environmental resources in general (such as water quality). Among other things, an increase in lumbering on ÖBf land would have to conform to already existing European or Austrian regulations concerning nature conservation (e.g., the Birds and Habitats Directives of the European Union). Furthermore, the Federal Forest Act [49,50] regulates forestry, for instance. Lumbering, therefore, has to conform to sustainability criteria specific to forests, such as harvesting not more than the average annual volume increment allows. As outlined by Getzner et al. [51,52], this hypothetical baseline scenario differs from the current management regime of multifunctional forestry on ÖBf land as follows:

- Increase in the amount of timber that is lumbered, and changes of the forest management practices within the legal limits of the forest and nature conservation laws (e.g., monocultures, shorter rotation periods from planting to lumbering, more clear-cuttings compared to small-scale or single-tree lumbering; it is assumed that the PEFC certification of all timber lumbered in ÖBf forests does not change); and
- the reduction of conservation efforts, as well as the limitation of protected areas to the legally feasible minimum.

For every plot of ÖBf land (forests) GIS data are available on land cover, on the intensity of forestry (e.g., tree species composition, age distribution), and on the ecological state. The most important input data for modelling the status quo, as well as the baseline scenario are data on land use, types of forests, management, and conservation areas on ÖBf land (Table 1).

Table 1. Categories of land, conservation, and intensity of commercial forestry in the current management framework and the (hypothetical) baseline scenario.

Categories of Land	*Total Area (hectares)*	*Share of Land Categories (% of total area)*	*Current Management (status quo)* [a]*: Multifunctional Forestry*	*Baseline Scenario*
Total ÖBf area (rounded)	844,000	100%	100%	100%
of which: forests	511,000	61%	61%	61%
Status of conservation [b]				
Strict conservation	-	-	8%	6%
Strong conservation	-	-	25%	20%
Weak conservation	-	-	17%	14%
Intensity of commercial forestry [c,d]				
Intensive commercial forestry [c,d]	336,000	40%	40%	++
Sustainable forestry [c,d]	5000			+
Protective forests without commercial use	97,280	12%	12%	0
Protective forests with commercial use	54,720	6%	6%	++
Other areas inside forests	18,000	3%		
Land with some conservation status (rounded, % of total land)			50%	40%
Degree of naturalness (measured by a biodiversity index based on the hemeroby concept) (mean on a 5-point scale; 5 = completely natural) [e]			2.80	2.50
Annual timber production (million solid m^3)			1.52	1.80

[a] The status quo is the current management framework (business-as-usual scenario) and includes the current practice of "multifunctional forestry". [b] The status of conservation only considers conservation policies that have a legal basis (e.g., in protected areas); it does not take into account conservation measures that are included in forest management plans on a voluntary basis (e.g., limitation of clear cutting, toleration of deadwood). Examples for strict conservation: wilderness areas, core zones of national parks; strong: nature conservation areas, Natura 2000 sites; weak: landscape conservation zones. [c] The increase in lumbering timber in the baseline is described only in qualitative terms. '++' indicates a significant increase in intensity, while '+' stands for weak intensification. The value of '0' refers to an unchanged intensity of forestry. [d] The current legal frameworks of commercial forestry do not, however, suggest that these practices are not bound to certain sustainability frameworks; for instance, commercial forests are sustainably managed along the principles of lumbering an amount of timber that does not exceed the corresponding growth. Furthermore, the Austrian Forestry Act and other legal frameworks provide for environmental standards of pursuing forestry. [e] The degree of naturalness is computed in a GIS model, taking into account 25 different indicators based on the hemeroby concept of Grabherr et al. [29]. The degree of naturalness is, therefore, not completely congruent with the concept of biodiversity. For instance, increasing the degree of naturalness might reduce biodiversity typical for high-alpine meadows. Source: Authors' concept and assumptions based on ÖBf data (extended version of Getzner et al. [51,52]).

The total area of ÖBf land amounts to 844,000 hectares. ÖBf land consists of forests and high alpine areas, such as meadows, glaciers, lakes and rivers. In total, 61% of ÖBf land (511,000 hectares) are forests of which 395,000 hectares (47% of total land) are used for lumbering timber. The current management practice of *multifunctional forestry* conserves about 50% of ÖBf land under various regulations from weak conservation (e.g., landscape conservation areas) to strict nature conservation (e.g., core zones of Natura 2000 sites, national parks and wilderness areas).

Table 1 also describes the change in the attributes of the baseline scenario as detailed above (see Getzner et al. [51,52]). For instance, lumbering would increase from 1.52 to 1.80 million solid cubic meters, and nature conservation areas would decline to about 40% of the total ÖBf land. Furthermore, the degree of naturalness of forests, computed by an index based on 25 separate ecological indicators, would decrease by about 10%. Getzner et al. [51] assess the degree of naturalness based on the hemeroby concept [53] on the basis of 25 different indicators, such as biodiversity (e.g., tree species composition) and conservation status, by means of a comprehensive GIS model. The database includes data on all plots of land managed by the ÖBf. Schirpke et al. [54] also use this concept to assess the role of landscapes for outdoor recreation (see also [55]). In other words, the current management secures an increase of naturalness and biodiversity conservation at the cost of lumbering timber. The economic evaluation of this marginal change in regard to recreation benefits is presented in the following sections.

3. Descriptive Survey Results

Table 2 shows that respondents perceive Austrian forests as being in excellent shape. Over 80% of the respondents believe that Austrian forests are in a good or very good ecological condition. Besides preserving the protective functions of forests, conserving nature, and managing forestry sustainably, respondents expect recreation opportunities and visitor infrastructure from the Austrian Federal Forests (ÖBf).

Table 2. Descriptive survey results: Perception of naturalness, and distance of respondents to forests.

Survey Subject	*Share of Respondents/Value of Variable*
Perceived ecological condition of Austrian forests	
Very good/good ecological condition	81.5%
Condition of the forest closest to the respondent's home	
Natural forest	12.7%
Good ecological status	56.8%
Little naturalness	16.4%
Artificial forest	6.7%
(Self-reported) Distance of the respondent's household to the next forest	
up to 3 km	62.4%
3 to 5 km	17.2%
5 to 10 km	10.6%
more than 10 km	9.9%
Austrian residents living in a certain distance to the next forest	
up to 3 km	5.331 million (62.34%)
3 to 5 km	1.469 million (17.18%)
5 to 10 km	0.905 million (10.58)
more than 10 km	0.846 million (9.89%)
Austrian residents living in a certain distance to the next forest owned by the Austrian Federal Forests (ÖBf)	
up to 3 km	2.064 million (39.02%)
3 to 5 km	0.459 million (8.68%)
5 to 10 km	1.644 million (31.08%)
more than 10 km	1.122 million (21.21%)
Distance from the respondent's household to the next (closest) forest	4.56 km (mean) 2.00 km (median) 5.30 km (std. deviation)

Total no. of respondents n = 1501. Source: Own survey, calculations and GIS-analysis (cf. [52]).

About 62% of the respondents live close to forests at a distance of up to 3 km; 17.2% of the respondents live at a distance of about 5 km to the next forest. Only 10% of the respondents live at a distance of more than 10 km. This means that—based on the respondents' answers—about 7.7 million Austrian residents (of 8.6 million in total) live within a distance of up to 10 km to forests (the mean distance amounts to 4.56 km with a median of 2.00 km; see Table 2). About 4.2 million Austrian residents live within a distance of up to 10 km to ÖBf forests.

About 13% of the respondents perceive the forest closest to their home as a natural forest; while 57% of the respondents believe that the nearest forest is at least in a good ecological status.

The vicinity to forest ecosystems seemingly influences the respondents' local recreation activities (see Figure 2 for the frequency of trips; Table 3). The most frequent recreation activities of the respondents are walking and hiking with others (family) or alone, which is about 86% and 84% of the respondents, respectively. On average, respondents visit forests about 1.5 times per month to go for a hike or a walk (about 15 to 17 times per year). These activities are often combined with wildlife observation or picking plants and mushrooms. Furthermore, cycling and mountain biking are very popular. The least frequent activities are fishing and hunting.

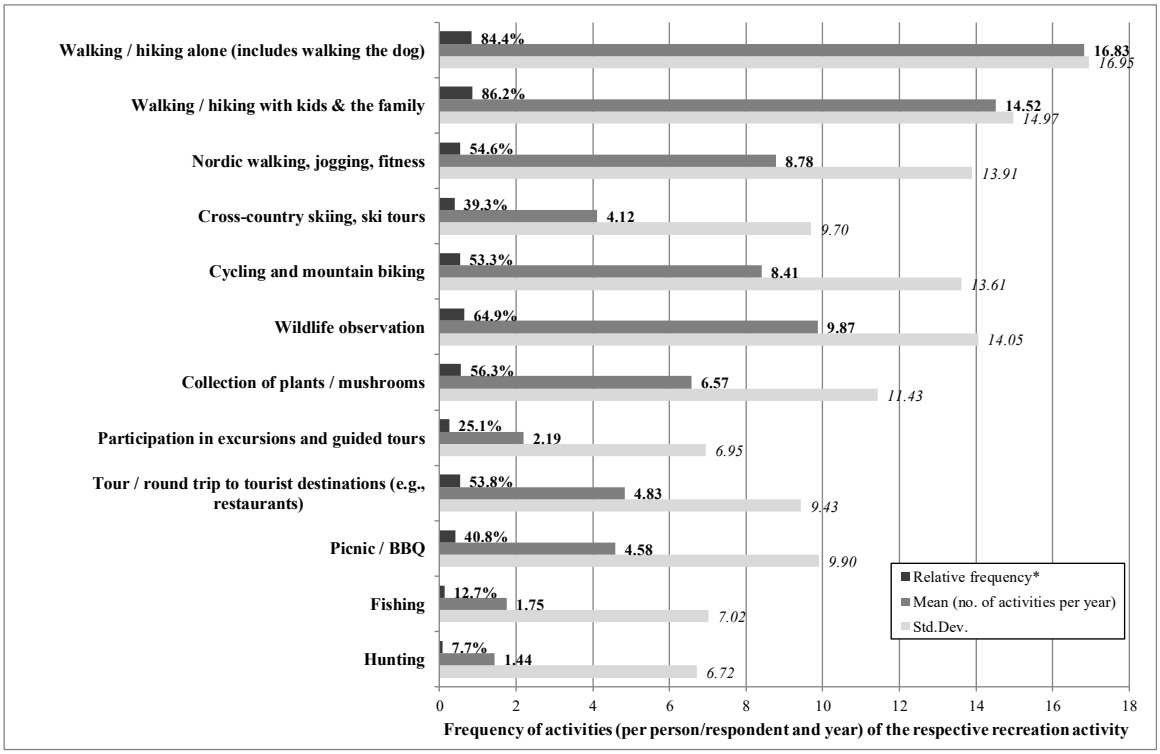

Figure 2. Local recreation activities of respondents in Austrian forests. * The relative frequency reports the share of respondents (n = 1501) who undertook the respective activity at least once a year. Example: 84.4% of respondents walked or hiked alone in a forest once during the last year; the average (mean) frequency per respondent per year is about 16.83 times, with a standard deviation of 16.95 times per year. Source: Own survey and calculations.

Recreation activities take place in different kinds of forests. For instance, natural or close-to-natural forests are preferred for walking and hiking, and for wildlife observation and the collection of plants and mushrooms. In addition, travel distances, the choice of travel modes, and the importance of quietude for the respective recreation activities are varied, as are seasonal activities over the year [56].

Table 3. Perceived naturalness of the forest depending on recreation activities.

Activity	*No. of Respondents*	*Share of Respondents Pursuing the Resp. Activity*	*Perceived Naturalness of the Forest of the Respective Activity (1 = completely natural, 4 = not natural at all)*	
			Mean	*Std. Dev.*
Walking/hiking alone (includes walking the dog)	1267	84.41%	1.99	0.71
Walking/hiking with kids & the family	1294	86.21%	2.04	0.66
Nordic walking, jogging, fitness	820	54.63%	2.26	0.77
Cross-country skiing, ski tours	590	39.31%	2.79	0.97
Cycling and mountain biking	800	53.30%	2.40	0.84
Wildlife observation	974	64.89%	1.82	0.71
Collection of plants/mushrooms	845	56.30%	1.77	0.69
Participation in excursions and guided tours	377	25.12%	2.01	0.80
Tour/round trip to tourist destinations (e.g., restaurants)	808	53.83%	2.29	0.79
Picnic/BBQ	613	40.84%	2.31	0.84
Hunting	116	7.73%	2.04	0.84
Fishing	190	12.66%	2.13	0.82

Total no. of respondents n = 1501. Source: Own survey and calculations.

In Table 3 the respondent's perception of the naturalness of the forest visited for recreation activity is given. Measuring the respondents' perception of *naturalness* is not straightforward. As described before, the respondents were presented different pictures and given a short description (see also [21]). Sana and Eja [57] recently pointed out that the meaning and concept of naturalness is diverse and generally not easy to communicate. As may be expected, the perceived naturalness on the four-point scale (see Figure 1; 1 = natural forest; 4 = artificial forest) is highest for forests where respondents went for slow and contemplative activities such as walking and hiking, wildlife observation and picking berries and mushrooms. For activities that include sports and exercises (e.g., cycling), the perceived naturalness is lower (Table 3). In regard to the choice of recreation activities and the degree of naturalness of forests, one cannot readily interpret the correlation between both as a causal relationship. Visitors may choose the location of their activities according to the forest attributes, and some forest characteristics may attract certain recreation activities. For instance, less dense forests with slopes and trails may attract mountain bikers; dense and natural forests may attract visitors looking for mushrooms.

A similar pattern can be detected regarding the perceived quietude, and disturbance through artificial sounds, respectively (Table 4). Quietude and natural sounds are most important when observing wildlife and collecting plants. Walking and hiking are also dependent on a natural quietude, while sports activities take place in forests where respondents consider quietude not equally important. Interestingly, the sensitivity to and perception of disturbances by artificial sounds is highest for the activities of hunting, fishing, and picnic activities – for the latter, sounds may stem from other families picnicking. However, perceived artificial noise levels do not necessarily correspond to objective (measurable) noise levels.

The choice of the transport mode for each recreation activity is again different, as expected. Cycling and walking to the forest are the most frequent ways to get there for local recreation activities (up to 5 km). Some respondents use cars for their activities that need some equipment (e.g., for fishing and hunting) (see Table A1 in the Appendix B).

Table 4. Perceived quietude depending on recreation activities in forests.

Activity	*No. of Respondents*	*Levels of Noises (quietude) in the Forest(% of Respondents Pursuing the Resp. Activity)*			
		Only Natural Noises	*Some Artificial Noise*	*Intensive & Permanent Artificial Noises*	*Disturbance by Artificial Noises (Some or Intensive)*
Walking/hiking alone (includes walking the dog)	1267	48.86%	47.91%	3.24%	16.26%
Walking/hiking with kids & the family	1294	46.52%	50.46%	3.01%	16.23%
Nordic walking, jogging, fitness	820	37.68%	56.83%	5.49%	15.49%
Cross-country skiing, ski tours	590	28.81%	53.05%	18.14%	13.73%
Cycling and mountain biking	800	35.13%	58.25%	6.63%	13.50%
Wildlife observation	974	62.94%	34.70%	2.36%	17.35%
Collection of plants/mushrooms	845	63.55%	33.96%	2.49%	13.85%
Participation in excursions and guided tours	377	36.34%	57.82%	5.84%	19.89%
Tour/round trip to tourist destinations (e.g., restaurants)	808	25.62%	59.78%	14.60%	19.18%
Picnic/BBQ	613	37.36%	53.51%	9.14%	22.35%
Hunting	116	52.59%	43.10%	4.31%	27.59%
Fishing	190	48.95%	44.21%	6.84%	27.37%

Total no. of respondents n = 1501. Source: Own survey and calculations.

4. The Value of Naturalness and Quietude for Local Recreation

In order to ascertain the economic value of local recreation, Table 5 presents the results of the individual travel cost model including the 95% confidence intervals of the coefficients of the estimations.

Table 5. Estimates from the negative binomial regression[a.]

Dependent Variable: Frequency of Trips to the Preferred Forest for Local Recreation Activities.	*Coefficient*	*z-Statistic*	*Prob.*	*95% Confidence Intervalsof Coefficients*	
				Lower Bound	*Upper Bound*
Constant	2.962	93.13	***	2.901	3.023
Travel costs = measured by the travel distance (in km) to the preferred forest for local recreation.	−0.025	11.66	***	−0.027	−0.022
Activities = 1 for the respective recreation activity (see list below); the activity "Walking/hiking alone (includes walking the dog)" is the baseline activity.					
Walking/hiking with kids & the family	−0.096	3.87	**	−0.174	−0.017
Nordic walking, jogging, fitness	−0.185	5.11	***	−0.273	−0.096
Cross-country skiing, ski tours	−0.393	7.09	***	−0.496	−0.290
Cycling and mountain biking	−0.107	2.63	**	−0.197	−0.017
Wildlife observation	−0.280	8.48	***	−0.365	−0.196
Collection of plants/mushrooms	−0.489	11.88	***	−0.579	−0.399
Participation in excursions and guided tours	−0.702	10.39	***	−0.821	−0.582
Tour/round trip to tourist destinations (e.g., restaurants)	−0.505	9.84	***	−0.600	−0.411
Picnic/BBQ	−0.471	9.39	***	−0.569	−0.372
Hunting	−0.039	0.47	-	−0.231	0.152

Table 5. *Cont.*

Dependent Variable: Frequency of Trips to the Preferred Forest for Local Recreation Activities.	*Coefficient*	*z-Statistic*	*Prob.*	*95% Confidence Intervalsof Coefficients*	
				Lower Bound	*Upper Bound*
Fishing	−0.246	3.09	**	−0.401	−0.090
Degree of naturalness = 1 if the respondent perceives the preferred forest as a natural forest (highest degree of naturalness)	0.329	7.84	***	0.273	0.384
Quiet = 1 if respondent could only hear natural sounds	0.127	3.64	***	0.081	0.172
Adj. R^2			0.109		
S.E. of regression			14.029		
Log likelihood			−31,684.640		
LR statistic			94,696.6***		
n (total number of observations included)			8694		
N (number of respondents)			1501		

[a] Count-data model, negative binomial distribution assumed; latent demand model with ID clusters. Level of significance: *** $p < 0.01$, ** $p < 0.05$. VIF (variance inflation factors) amount to 1.08 to 1.60 for the coefficients of the estimation; multicollinearity is therefore not a major problem (details can be requested from the authors). Source: Own survey and calculations.

The distance traveled is highly significant in the estimation with the expected (negative) sign. In addition, travel frequency increases both with the perceived degree of naturalness of the forest, and with the quietude (i.e., visitors can hear only natural sounds). The trip frequency depends largely on the type of activity (the rather small adj. R^2 value is common to this type of estimations and cannot be compared to R^2 values of OLS estimations). Table 6 presents the calculation of annual local recreation benefits per activity and per respondent and includes the lower and upper bounds of the recreation benefits based on the confidence intervals of the coefficients of the travel demand model. For instance, the value of taking part in excursions and guided tours is highest among all activities.

Table 6. Economic values of the benefits of local recreation in Austrian and ÖBf forests.

Activity	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Walking/hiking alone (includes walking the dog)	−0.02	40.58	0.47	18.88	18.41	309.84	279.87	346.80
Walking/hiking with kids & the family	−0.10	44.46	0.67	29.99	29.31	425.63	412.68	441.61
Nordic walking, jogging, fitness	−0.18	48.08	0.44	21.26	20.82	182.78	177.80	188.92
Cross-country skiing, ski tours	−0.39	56.52	1.66	94.10	92.43	380.38	369.73	393.53
Cycling and mountain biking	−0.11	44.93	0.63	28.34	27.71	232.94	227.97	239.09
Wildlife observation	−0.28	51.96	0.64	33.27	32.63	322.05	310.74	336.00
Collection of plants/mushrooms	−0.49	60.43	1.01	60.96	59.95	394.04	378.20	413.57
Participation in excursions and guided tours	−0.70	69.06	1.11	76.67	75.56	165.83	160.64	172.22
Tour/round trips to destinations (e.g., restaurants)	−0.51	61.10	1.74	106.02	104.28	503.69	484.54	527.31
Picnic/BBQ	−0.47	59.69	0.88	52.45	51.58	236.47	228.36	246.48
Hunting	−0.04	42.18	0.94	39.86	38.91	55.92	50.79	60.08
Fishing	−0.25	50.55	1.10	55.72	54.62	95.81	93.57	97.63

n = 1501 respondents undertaking 8694 recreation activities in forests per year. (1) Coefficient of the econometric estimation (see Table 5). (2) Gross benefits (consumer surplus) of local recreation (km). (3) Average travel costs (weighed average of the travel costs with respect to the travel mode) (EUR per trip). (4) Gross recreation benefit (EUR per trip). (5) Net recreation benefits (consumer surplus) after deduction of travel costs (EUR per trip). (6) Total recreation benefits per respondent per year (EUR per year) based on net recreation benefits. (7) Lower bound of recreation benefits based on the 95% confidence interval of the travel demand model. (8) Upper bound of recreation benefits based on the 95% confidence interval of the travel demand model. Source: Own survey and calculations.

The first column in Table 6 shows the estimated coefficients of the travel demand model (taken from Table 5). The coefficients lead to gross benefits of the respective activity (gross consumer surplus measured in km) by their reciprocal ratio to the constant of the estimation in Table 5 (second column). The third column displays the travel costs in EUR per km as a weighted average of the travel costs per mode of transport. For instance, the average costs of traveling to the forest for walking and hiking purposes are about EUR 0.50 to 0.60 per trip. Higher travel costs are associated with less frequent activities, such as tours and roundtrips, hunting and fishing. The fourth and fifth column show gross and net recreation benefits per activity (EUR per activity). Combined with the average frequency of activity per respondent, and aggregated to the total sample, the mean recreation benefits of all respondents and all activities are estimated at about EUR 3305 per person and year. As the sample of the survey was strictly representative as mentioned already, it is reasonable to assume that the average Austrian household holds comparable preferences for local recreation. Taking the relevant Austrian population (5.289 million residents) as a basis for calculation, the total forest-related recreation values of all Austrian residents amount to EUR 17.454 billion per year. We base our calculation on the age categories of respondents in the sample; therefore, we subtract all Austrian residents younger than 18 and older than 65 from the total population of Austria (8.544 million residents) in order to provide a conservative estimate of total recreation benefits.

Taking into consideration the average travel costs and the coefficients estimated for naturalness as well as quietude (Table 7), the marginal values of these two attributes of forests can be computed. If all forests were natural forests with the highest degree of naturalness, the annual recreation benefits would be higher by about EUR 1100 (per person and year). This is a hypothetical value, since it would be unrealistic to believe that all Austrian forests could develop into forests of the highest degree of naturalness. Recreation activities would also be in conflict with policies to conserve such natural forests, for instance, in core zones of national parks or in areas that are a wilderness. In addition, this value assumes a constant marginal utility of recreation.

Table 7. Per-capita economic values of the benefits of local recreation in Austrian and ÖBf forests depending on naturalness and quietude.

	Mean	*Lower Bound*	*Upper Bound*
All Austrian forests (100%)			
Total average recreation benefits per respondent per year for all activities in all Austrian forests (EUR) (Sum of column (6) of Table 6)	3305.36	3188.23	3449.90
Additional recreation benefits in natural forests (additional consumer surplus) per respondent and year (EUR) (i.e., if all forests were in a natural state) [a]	1086.24	871.64	1324.30
Additional recreation benefits in quiet forests (additional consumer surplus) per respondent and year (EUR) (i.e., if only natural sounds could be heard in all forests) [b]	419.11	259.49	594.07
Forests on ÖBf land (15%)			
Total average recreation benefits per respondent per year for all activities in ÖBf forests (EUR) (this is 15% of EUR 3305.36 per person and year)	495.80	478.23	517.48
Additional recreation benefits in natural forests (additional consumer surplus) per respondent and year (EUR) (i.e., if all ÖBf forests were in a natural state) [a]	162.94	130.75	198.65
Additional recreation benefits in quiet forests (additional consumer surplus) per respondent and year (EUR) (i.e., if only natural sounds could be heard in all ÖBf forests) [b]	62.87	38.92	89.11

[a] Value of higher naturalness of the forest visited in terms of larger travel distances or higher trip frequency. The computation of the value of a higher naturalness of the forest is based on the relative coefficients of the econometric estimations in Table 5, combined with weighed total average travel costs. The natural condition is based on the assessment of the degree of naturalness according to the hemeroby concept [53,54], and was presented to respondents by descriptions and pictures in the questionnaire (see Figure 1). [b] Value of quietude in forests (only natural noises can be heard) in terms of larger travel distances or higher trip frequency. Noise and noise pollution were described in the questionnaire in three broad categories: (1) only natural noises can be heard; (2) mixed natural and artificial noises; (3) artificial noises are predominant. The computation of the value of the natural condition of the forest is based on the relative coefficients of the econometric estimation displayed in Table 5. Source: Own survey and calculations.

Furthermore, if only natural sounds could be heard (natural quietude), recreation benefits would be higher by EUR 420 (per person and year). Realistically, the scope of forest managers to increase natural sounds by reducing artificial sounds is small. Landowners and managers, such as the ÖBf, are often not in the position to influence existing transport infrastructures, air traffic or the zoning and use of commercial or residential areas. In Section 5 below, the options of forest management to increase recreation benefits by improving the naturalness of forests, as well as increasing quietude are discussed.

As described above, about 15% of forests in Austria are public forests managed and owned by the ÖBf. Respondents also indicated that they visited ÖBf forests for about 14.9% of all activities. The proportional recreation benefits stemming from ÖBf forests therefore amounts to about EUR 496 (per person and year). If all ÖBf forests had the highest degree of naturalness, recreation benefits would increase by about EUR 163 (per person and year). If people looking for rest and relaxation would hear only natural sounds, recreation benefits of ÖBf forests would be higher by EUR 63 (per person and year) (see Table 6).

While total values of recreation benefits are interesting by themselves, we now turn to discussing the scope of forest management to increase recreation benefits, and to assess the differences between the current management framework (*multifunctional forestry*) and the baseline scenario.

5. The Potential Benefits of the Current Management Framework to Sustain the Value of Local Recreation

Based on the recreational benefits derived from the nationwide survey, our goal is to ascertain the recreation values of the current management regime (*multifunctional forestry*) on ÖBf land in comparison to the above-described baseline scenario – the former sustaining local recreation benefits by increasing the degree of naturalness and quietude. We therefore investigate to what extent the current management regime (multifunctional forestry) generates benefits compared to the hypothetical baseline scenario formulated for this investigation (see Section 2). Forest management includes all policies and measures related to the amount of lumbered timber, and to biodiversity and naturalness of the forest. Management plans account for changing the tree species composition (e.g., monocultures vs. diverse tree species), lumbering cycles, the amount of deadwood, size of clear cuttings, and wildlife management in order to limit damages to natural regeneration processes.

With respect to the options of management to increase recreation benefits, the design of the scenario has to consider the following aspects:

- Forests are open and accessible to the public for recreation purposes according to Austrian law.
- Recreation activities do not equally depend on the naturalness of the forest. Some activities, such as cycling do not rely on ecological forest management while the naturalness of the forest influences other activities, such as walking or wildlife observation.
- Quietude in forests is important for many types of recreation but forest owners and managers cannot increase natural quietude. Rare exceptions are the restriction of access to certain areas (e.g., banning cars or reducing picnic facilities), and the limitation of noise from lumbering to hours with fewer visitors. Most artificial noises that can be heard in forests (such as noise from infrastructures and air transport; see [20]), cannot be prevented by landowners.
- The density of vegetation may reduce noise to some extent. Forest management may increase the density of vegetation and lead to a higher degree of naturalness.

Table 8 outlines the specific recreation benefits secured and provided by the current management framework on ÖBf land in contrast to the hypothetical baseline scenario.

Table 8. Economic value of recreation on ÖBf land based on current multifunctional forestry compared to the hypothetical baseline scenario (in EUR million).

Local Recreation in All Austrian Forests [a]	*Values (EUR million)*
Total recreation benefits	8342
Additional total recreation benefits if all forests had the highest degree of naturalness	2741
Additional total recreation benefits if only natural noises could be heard	1058
Local recreation in ÖBf forests (15% of total forest area)	
Total recreation benefits	1251
Additional total recreation benefits if all forests had the highest degree of naturalness	411
Additional total recreation benefits if only natural noises could be heard	159
Increase of recreation benefits with current management by increased naturalness in ÖBf forests [b]	42.26
Increase of recreation benefits by a reduction of artificial sounds owing to less lumbering [c]	1.20
Increase of recreation benefits by a reduction of artificial sounds owing to an increased density of forests (higher degree of naturalness) [d]	2.04
Sum of increased recreation benefits owing to the current status quo in comparison to the baseline scenario	45.5

[a-d] All footnotes explaining the calculation of variables and the results are presented in Appendix C of this paper. Source: Own survey and calculations.

The upper part of Table 8 presents total and additional recreation benefits in all Austrian forests and, proportionally, in ÖBf forests. Based on the total recreation benefits per person and year (Table 6), the total local recreation benefits for the population living within a radius of five kilometers from ÖBf forests amount to EUR 1251 million. If all ÖBf forests were of the highest degree of naturalness, additional recreation benefits would amount to EUR 411 million. If only natural sounds could be heard (i.e., a quiet forest), recreation benefits would increase by EUR 159 million. Both figures are based on the assumption of a linear relation between naturalness, quietude, and the increase of recreation benefits. Furthermore, such calculation also ignores that there are trade-offs between the degree of naturalness and recreation activities.

Thus, Table 8 includes estimations of the effects of the current forest management on the naturalness of ÖBf forests in order to result in marginal benefits. On the one hand, the degree of naturalness would be lower by 10.3% compared to the baseline scenario according to the ecological assessment by Getzner et al. [51]. Combining this decrease with the marginal value of enhanced recreation benefits for naturalness, an estimate of additional benefits of about EUR 42.26 million for the local population is arrived at (around EUR 17 per person and year), assuming a linear relation between naturalness and recreation benefits. A linear relationship between naturalness and recreation benefits is in this case justified, since the marginal change (difference of 10.3%) is rather small. It is a reasonable assumption that, for this small change, there will not be major conflicts between a higher degree of naturalness and recreation activities. In other words, the current management framework secures recreation benefits of the local population of EUR 42.26 million in comparison to the baseline scenario.

On the other hand, the assessment of the influence of forest management on quietude and natural sounds, has to rest on a broader set of assumptions. The estimations in Table 8 display two approaches. First of all, lumbering (work) in forests causes artificial noises. Lumbering, for instance, uses various kinds of machinery. However, noises from lumbering are only prevalent on workdays. 41% of local recreation activities take place on workdays, 59% on weekends. Recreation benefits of EUR 65 million

correspond to activities on workdays (out of total recreation benefits attributed to quietude of EUR 159 million during the whole week).

Furthermore, the ÖBf are currently lumbering about 15.6% less timber than in the baseline scenario. If it is assumed that the share of all artificial noises stemming from lumbering amounts to 10%, additional recreation benefits for the local population owing to a reduction of artificial sounds amount to EUR 1.20 m. This rather small amount emphasizes that forest management generally has little influence in reducing artificial noises in forests.

Secondly, the density of forest vegetation may somewhat reduce artificial noises originating from infrastructures and commercial areas. However, the noise-absorbing capacity of forests is generally overestimated. A denser vegetation (e.g., shrubs, understorey, and conifers) may reduce artificial noises but only to a small extent. Acoustic studies have shown that, within a range of 100 m, a denser forest may reduce sound pressure by 3 to 10 dB. This corresponds to a reduction of existing noise by 50% to 90%, compared to a forest where trees would stand wide apart without shrubs or understorey (cf. [58,59]). The household survey indicated that about 17% of the respondents are disturbed by artificial sounds during their recreation activities (this is the weighted mean based on the frequency of activities; see Table 4). By combining the higher degree of the naturalness of forests (10.3% compared to the baseline) and this annoyance ratio, the economic value of a less noisy forest environment amounts to about EUR 2.04 million per year for local recreation activities. Again, this rather small marginal increase of recreation benefits indicates that the increased noise absorption by the current management framework, compared with the baseline scenario, is negligible. As a whole, noise reduction by the current management regime as compared with the scenario of intensive commercial forestry secures annual recreation benefits of approx. EUR 3.24 million (EUR 1.28 per person and year).

6. Results and Discussion

This paper deals with an evaluation of recreation benefits as a major cultural ecosystem service provided by forests on about 10% of Austrian land owned by the Austrian Federal Forests (ÖBf, *Österreichische Bundesforste*). In a representative household survey on local recreation activities combined with travel costs, respondents assessed the degree of naturalness and quietude (audibility of and disturbance by artificial noises). In order to value the local recreation benefits and their dependence on naturalness and quietude, a travel demand model includes two variables denoting the degree of naturalness and quietude.

As a conservative estimate, total benefits owing to local recreation in Austrian forests may amount to EUR 3300 per person and year. This result indicates that local recreation benefits stemming from forest-related activities, such as walking, hiking, mountain biking, wildlife observation, and picnicking, are substantial. However, the total value of these benefits cannot be used directly for forest management, or generally, for drawing any policy conclusion.

If all Austrian forests had the highest degree of naturalness, annual recreation benefits would be higher by about EUR 1090 per person. In addition, if all people seeking rest and relaxation would hear only natural sounds, recreation benefits would increase by EUR 420 per person. Proportionally, ÖBf forests provide total benefits of about EUR 500 per person and year. If all ÖBf land were to exhibit the highest degree of naturalness, annual benefits would increase by about EUR 160 per person and year. If there were only natural sounds in the ÖBf forests, the annual recreation benefits would increase by EUR 60 per person.

Compared with other studies, the recreation benefits ascertained in this paper are well within the range of recreation benefits presented in the current scientific literature. On the one hand, the frequency of visits in our study is comparable to, for instance, the study by Elsasser and Weller [60], who find that about 75% of the population visit forests at least once per year. On the other hand, their study reveals a mean willingness to pay for visiting forests of EUR 36 per person (Elsasser and Weller [60] use contingent valuation to ascertain visitors' willingness to pay; the results are, therefore, not directly comparable to our travel cost approach). In their meta-analysis of 26 travel cost studies

on the recreation benefits of forests, Zandersen and Tol [2] ascertain per-visit benefits ranging from EUR 0.66 up to EUR 122. As Bösch et al. [61] show, consumer surplus of a full day visit to forests in Germany may range from 2 to 28 EUR per person. De Salvo and Signorello [62] provide an overview of meta-analyses on studies estimating the consumer surplus of outdoor recreation. Mean consumer surplus in diverse studies range from USD 21 to 112 (2013 prices) per day. The authors also provide their own estimation; consumer surplus per visit amounts to USD 15 (2013 prices) with significant markups for wildlife observation and picking mushrooms. Schägner et al. [63] estimate a mean consumer surplus per person and visit of EUR 7 for European areas for recreation, depending largely on the type of ecosystem and the region. They, however, also emphasize the wide range of values in their meta-analysis. Mayer and Woltering [64] provide similarly wide ranges of estimates from about EUR 4 to 60 per day (cf. [47]). Getzner [65] estimates recreation benefits along the Mur River in the Austrian province of Styria to range from EUR 24 to EUR 130 per person per trip.

In this paper, the recreation benefits (consumer surplus) range from about EUR 19 (for local recreation) to EUR 106 (for longer-distance activities with car use such as hunting and fishing) per person and visit to a forest.

However, this study may not be fully comparable with other assessments of recreation benefits as the authors explicitly discuss the marginal change of local recreation benefits brought about by the *current* management framework in comparison to a baseline scenario. In this (hypothetical) baseline scenario, the amount of timber that is lumbered is increased to the existing legal limits of the forestry and nature conservation regulations. In this baseline scenario, the lumbering of timber would be extended by about 15.6%.

Therefore, comprehensive GIS and ecological models are used to model the differences between the current management and the baseline scenario. The models account for the spatial expansion of protected areas on ÖBf land, the amount of lumbered timber, and the degree of naturalness on the basis of the hemeroby concept.

The marginal (additional) value of local recreation benefits sustained by the current management framework in contrast to the (hypothetical) baseline is, of course, much smaller than the total recreation benefits outlined above. The increase in naturalness of ÖBf forests leads annually to an increase of recreation benefits of about EUR 15 per person and year. For the whole local population living in a distance of up to 5 km to the next forest, the total additional benefits amount to EUR 42.26 million per year.

In regard to quietude and natural sounds, additional recreation benefits are even smaller. Forest owners can hardly influence noise emissions from certain infrastructures (e.g., highways), from commercial areas adjacent to forests, or from air traffic. There are only two possible non-exclusive policies. First of all, managers may reduce noise from lumbering. Second, an increased naturalness with denser vegetation (e.g., shrubs, understorey) increases the noise absorption capacity of forests. The current management regime, however, only secures recreations benefits of about EUR 3.24 m per year (EUR 1.3 per person and year).

While the approach of this paper is straightforward, the study has a number of limitations. In the household survey, it was not possible to account for potential substitute areas or other opportunities of recreation. For instance, if a forest were not accessible for recreation owing to clear-cuts, residents would possibly choose another forest as their destination for local recreation. However, for local recreation, the potentials for substitute forests are more limited than for residents who are prepared to drive distances more than 5 km.

Furthermore, this paper rests on the assumption that forest visitors do indeed perceive changes in the forest environments. For instance, small changes in the degree of naturalness might not lead to significant changes in behavior. In addition, the time budget for recreation activities in forests is limited. An increased degree of naturalness does not necessarily lead to a higher frequency of visits. Rather, the recreation benefits derived from a visit may be higher with an increased degree of naturalness or a quieter environment.

7. Conclusions

As a general conclusion of this paper in terms of methodology and policy relevance, this paper takes into account the often-heard critique that studies on the valuation of ecosystem services are not thorough in terms of designing management scenarios and programs. Therefore, the authors have carefully designed a plausible baseline scenario in order to describe the potential benefits sustained by the current management practices. Recreation benefits sustained by the current management regime are significant. The results therefore indicate that future management strategies may increase recreation benefits by the extension of protected areas, and by the reduction of lumbering. Furthermore, the results suggest that forest management has a higher impact on recreational benefits through the naturalness of forests than through reducing artificial noise. A more sustainable forest management could further increase the benefits people derive from both naturalness and lower levels of artificial noise.

However, managing forests in order to maximize recreational benefits could lead to revenue losses because of the reduction in lumbering timber, for example. These trade-offs have to be taken into account for programs that would not only bring about a marginal change of the naturalness of forests, but would substantially increase areas that are a wilderness and core zones with restricted access, as well as a substantial reduction of forestry revenues. In the scenario explored in this paper, the conflicts between forestry, nature conservation and recreation are still manageable and small. A much more extensive nature conservation program may, therefore, lead to such trade-offs and conflicts. The results of the paper compiled by Getzner et al. [21] suggest that respondents expect such possible conflicts and express less additional willingness to pay for stricter conservation programs. Still, these conflicts have to be left to future research.

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Appendix A. Selected Questions of the Representative Household Survey

Q9: Please think about the activities of local recreation that you enjoy in forests, i.e., on single days or evening during the week or at the weekend. How often do you pursue the following activities?

- Walking/hiking with kids & the family
- Nordic walking, jogging, fitness
- Cross-country skiing, ski tours
- Cycling and mountain biking
- Wildlife observation
- Collection of plants/mushrooms
- Participation in excursions and guided tours
- Tour/round trip to tourist destinations (e.g., restaurants)
- Picnic/BBQ
- Hunting

- Fishing

[Matrix answer options:]

- Very often (about 1 time per week)
- Often (2 to 3 times per month)
- Not too often (about 1 time per month)
- Rarely (3 to 5 times per year)
- Very rarely (1 to 2 times per year)
- Almost never (more rarely than 1 time per year)
- Never (no activities in the last 5 years)

Q9a [for activities undertaken at least 1 to 2 times per year]: Please tell us the distance between your residence and the forest in which you pursue these activities!
[Matrix answer options:]

- Up to 3 km
- Up to 5 km
- Up to km
- Up to km
- Up to km
- Up to km
- 26 km or more

Q9b: Please tell us in which season you mainly pursue these activities!
[Matrix answer options:]

- Mostly during the summer half-year (spring to fall)
- During the winter season
- All year round

Q9c: Please tell us when you undertake these activities!
[Matrix answer options:]

- Rather during the week
- Rather on weekends
- Regardless of the day (during the week and on weekends)

Q9d: Please tell us the degree of naturalness of the forest where you undertake these activities!
[Matrix answer options:]

- Natural forests: Old-growth forests without management and forestry use
- Good ecological status: forests close to a natural state, with little management, tending, or use
- Little naturalness: Forests with sustainable forestry and limited clear-cuts
- Artificial forest: Intensive forestry and regular large-scale clear cuts

Q9e: How do you perceive the noise level in the forest where undertake these activities?
[Matrix answer options:] I hear . . .

- . . . only natural sounds
- . . . some artificial noise
- . . . intensive and permanent artificial noises

[If " … some artificial noise" or " … intensive and permanent artificial noises" were ticked by respondents, the following sub-question was asked:] Do you feel disturbed by these noises during your activities?
[Matrix answer options:]

- Yes
- No

Appendix B. Additional Data and Information on the Transport Mode Choice of Respondents

Table A1. Transport mode choice of respondents for activities of local recreation.

Activity	*By Foot*	*Bicycle*	*Car*	*Public Transport*	*Mean Distance (km)*[a]
Walking/hiking alone (includes walking the dog)	62.1%	4.6%	24.3%	9.0%	5.1
Walking/hiking with kids & the family	52.2%	5.5%	36.5%	5.8%	7.1
Nordic walking, jogging, fitness	75.4%	4.5%	17.9%	2.2%	5.0
Cross-country skiing, ski tours	21.3%	8.5%	66.0%	4.3%	15.9
Cycling and mountain biking	11.1%	78.7%	7.4%	2.8%	7.4
Wildlife observation	43.9%	9.8%	26.8%	19.5%	7.0
Collection of plants/mushrooms	33.3%	8.3%	54.2%	4.2%	10.0
Participation in excursions and guided tours	55.6%	0.0%	22.2%	22.2%	12.3
Tour/round trip to tourist destinations (e.g., restaurants)	6.3%	8.3%	79.2%	6.3%	15.9
Picnic/BBQ	15.4%	15.4%	65.4%	3.8%	8.4
Hunting	14.3%	0.0%	85.7%	0.0%	8.5
Fishing	18.8%	25.0%	56.3%	0.0%	10.9

[a] Mean distance (km) for all respondents and for all modes of transport (total n=1501); only those respondents with activities are included for computing the mean values. Source: Own survey and calculations.

Appendix C. Explanatory Footnotes to Table 8. Economic Value of Recreation on ÖBf Land Based on Current Multifunctional Forestry Compared to the Hypothetical Baseline Scenario (in Million EUR)

[a] Total benefits of local recreation in forests are derived from the total recreation benefits per person displayed in Table 6 multiplied by the relevant population living in a 5 km radius from the forest.

[b] The additional benefits of a higher degree of naturalness of the status quo compared to the baseline scenario are calculated by the following equation: $\Delta B_{nat,SQ} = B_{nat} \cdot \left(nat_{SQ} - nat_{BL}\right) \Big/ nat_{SQ}$. $\Delta B_{nat,SQ}$ denotes the increase of recreation benefits depending on the degree of naturalness for the status quo (current management) compared to the baseline scenario. B_{nat} are total recreation benefits (depending on the degree of naturalness), and nat_{SQ} and nat_{BL} are the degrees of naturalness for the status quo and the baseline scenario, respectively. As outlined in Table 1, $nat_{SQ} = 2.80$, while $nat_{BL} = 2.51$.

[c] The additional recreation benefits owing to increased quietude which are derived from a reduction of lumbering in *ÖBf* forests are computed by the following equation: $\Delta B_{ql,SQ} = B_q \cdot w \cdot nl \cdot \left(H_{BL} - H_{SQ}\right) \Big/ H_{SQ}$. $\Delta B_{ql,SQ}$ denotes the additional recreation benefits owing to a reduction of lumbering in ÖBf forests. B_q are total recreation benefits (depending on quietude). $w = 41.12\%$ and is the share of respondents pursuing their recreation activities during weekdays when timber is lumbered $nl = 10\%$ and denotes the share of artificial noises in forests stemming

from lumbering during weekdays. H_{BL} is the annual amount of timber lumbered in the baseline scenario, while H_{SQ} denotes the quantity of lumbered timber in the status quo. As outlined in Table 1, $H_{SQ} = 1.52$, while $H_{BL} = 1.80$.

[d] The additional recreation benefits stemming from a higher density of vegetation in *ÖBf* forests are calculated by the following equation: $\Delta B_{qv,SQ} = B_q \cdot d \cdot \left(nat_{SQ} - nat_{BL}\right) \Big/ nat_{SQ}$. The variable d denotes the share of respondents who feel disturbed by artificial noises stemming from infrastructures and residential areas outside of the forests that a more dense vegetation may reduce. It is assumed that the changes of the degree of naturalness can approximate the change of the density of the vegetation.

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