Assessment of the Recreation Value of Public Programs in the Jizerske hory Mountains Using a Contingent Behavior Model

by

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Abstract

This paper presents a travel cost study which was conducted for the purpose of estimating a recreation value to the Jizerske hory Mountains in the Czech Republic. In addition, the welfare change of recreation users associated with damage on the forest quality was estimated using contingent behavior model. In the study, the single site travel cost model with a Poisson specification was applied. The contingent behavior model relied on both observed behaviors and stated behaviors to infer the change of value associated with forest recreation in this area. Both actual trips and intended trips were pooled under the hypothetical scenario to estimate the value of four public programs, including the change in the forest quality. To gather information about respondents, the survey was conducted on-site during September and October, 2005. A total of 312 questionnaires were completed. The consumer surplus per trip to the site under the current conditions was about USD 18 using Poisson model, USD 17 (truncated Poisson) and USD 56 (truncated Negative Binominal). There was significant evidence of overdispersion that is why the negative binominal regression model was preferred to the Poisson model. The decrease in the welfare change in the access value associated with the impacts of air pollution on the quality of forest ecosystems was estimated at CZK 67 for one trip (USD 3).

Keyword: Forest Quality, Contingent Behavior, Single Site Travel Cost Model, Poisson, Negative Binominal

JEL classification: C24, D62, Q51

Introduction

The paper presents the main results from a travel cost study which was carried out in the Jizerske hory Mountains (JH Mts.) in summer 2005 in order to estimate recreational values of this mountain area. The JH Mts. are situated in the northern part of the Czech Republic and they are a favorite destination for summer and winter recreational activities such as hiking, mountain biking, cross-country skiing and downhill skiing. For their wealth of natural heritage sites the JH Mts. were designated a Protected Landscape Area (PLA) in 1968.

Seventy per cent of the mountains' area and the forest ecosystems have been damaged by the effects of air and ground pollution, insect infestation, changes in forestry composition and intensive exploitation since the 1970's. Because of the negative influence of these factors the forest ecosystems have been transformed into non-forest ecosystems for a long time, mainly in the central part of the JH Mts. The forest damage is very obvious to recreational users. They can see the defoliated spruce wood needles, the dead and fallen trees, and the deforested areas. These outcomes decrease the forest quality and detract from the aesthetical beauty of the forest. Thus, the value of the recreational experience in the JH Mts. is significantly lower compared to the other sites with higher quality of forest (Walsh, Ward, Olienyk, 1989; Walsh and Olienyk 1981).

Non-timber functions of forest, such as recreational and aesthetical services, are not traded on ordinary markets; therefore their monetary values are not known directly. Stated and revealed preference techniques are some of the methods that can be used when placing a monetary value on non-traded goods. When using a revealed preference technique, e.g. travel cost method (TCM), we rely on observed behavior of individuals or households. Contrary to TCM, stated preference techniques rely on stated behavior of individuals in response to hypothetical situations.

There are two main approaches which combine stated and revealed preference data. The first approach is the random utility framework of trip choice modeling. This model has been used e.g. by Adamowicz et al. (1997).

The second approach is the contingent behavior model, which combines observation from contingent behavior with observations of actual behavior by the same individuals, using either pooled or panel data models. Englin and Cameron (1996) were the first to use a panel data approach in a study of the economic benefits of recreational fishing in Nevada. The pooled data model was followed by Eiswerth et al. (2000), who used a Poisson model to estimate the economic benefits of protecting water levels at Walker Lake, Nevada.

In this study, the single site model is applied to infer recreational values values placed by visitors on the JH Mts. Observed and stated behaviors[1] of recreation users are used to estimate the welfare change associated with the four hypothetical programs that improve or degrade the environmental quality[2] in the area. The contingent behavior model with the Poisson specification is used to estimate the welfare changes.

The rest of this paper is organized as follows. Section 2 describes the economic foundation of the single site model and its welfare implications. Section 3 describes the study area. Section 4 outlines the sampling plan and the structure of the questionnaire. Section 5 presents descriptive statistics of the sample. Section 6 describes the econometrical model and presents estimates. Section 7 concludes.

1. Economic foundation

According to Kolstad (2000), when we use the single site travel cost model, we suppose that the individual's utility depends on a consumption of market goods, x, the number of trips to the recreation site, v and the environmental quality of site, q. Higher qs are better. We also assume a weak complementarity of the trips and the environmental quality of the recreation site, q. The individual's utility is not influenced by environmental quality if the individual does not visit the site ($\partial U/\partial q = 0$ when $v = 0$). Furthermore, v is increasing with q (see Alberini and Longo, 2005). We also assume that the price of x is unity. The out-of-pocket expenses related to a single trip to the recreation site (fuel expenses, costs on accommodation, admission and parking charges) are denoted as p_0. The individual works for L hours at a wage rate w. Then, the individual's utility maximization problem can be recorded as follows:

$$\max_{x,v} U(x, v, q) \tag{1a}$$

such that

[1] Observed behaviors are measured by the actual number of trips to the recreation site and stated behaviors are expressed as the number of trips realized to the recreation site under hypothetical conditions.

[2] The hypothetical scenarios proposed (i) the decline of the forest quality of spruce wood in the near future because of continuing air pollution, (ii) the change of forestry composition in a favor of plant broad-leaved trees which are more resistant against air pollution than spruce wood, (iii) the designation of the bird area as a Natura 2000 network which will cover 40% of the area. The purpose of the bird area is to protect and increase population of two endangered bird species: black grouse and little owl, and (iv) charging an entrance fee into the bird area.

$$wL = x + p_0 v \quad (1b)$$

Out-of-pocket expenses are not the only cost of visiting the recreation site. The individual must take time to visit the recreation site. Thus, T denotes the total time expressed in hours that is available to the individual for leisure activities and work. The travel time associated with a single round trip is t_t and the on-site time associated with single trip is t_v. The individual then faces a time-budget constraint that we can be recorded as follows:

$$T = L + (t_t + t_v)v \quad (1c)$$

Equation (1c) can be substituted into equation (1b) in order to eliminate L and thus reduce the maximization problem to

$$\max_{x,v} U(x, v, q) \quad (2a)$$

such that

$$wT = x + [p_0 + w(t_t + t_v)]v \equiv x + p_v v \quad (2b)$$

where

$$p_v = p_0 + w(t_t + t_v) \quad (2c)$$

The result of the maximization problem that is specified in equation (2) will be a demand function for trips to the recreation site:

$$v = f(p_v, q, y) \quad (3)$$

where y is income (wT). We can assume that the demand function is log-linear and therefore we can write the demand equation as follows, see e.g. Alberini and Longo (2005):

$$v = exp(\beta_0 + \beta_1 p_v + \beta_2 y + \beta_3 q) \quad (4)$$

Using the demand function specified in equation (3) we can measure willingness to pay for a small change in environmental quality of the site, q. In fact, this is exactly the problem determined in the context of restricted demand.

Once the demand function is estimated, we can assess the consumer surplus (CS). If we follow the demand equation defined in (3) the consumer surplus is equal to (see Haab and McConnell, 2002 and Alberini, Longo, 2005):

$$CS(p_{v0}, q_0) = -\frac{1}{\beta_1} v_0 \quad (5)$$

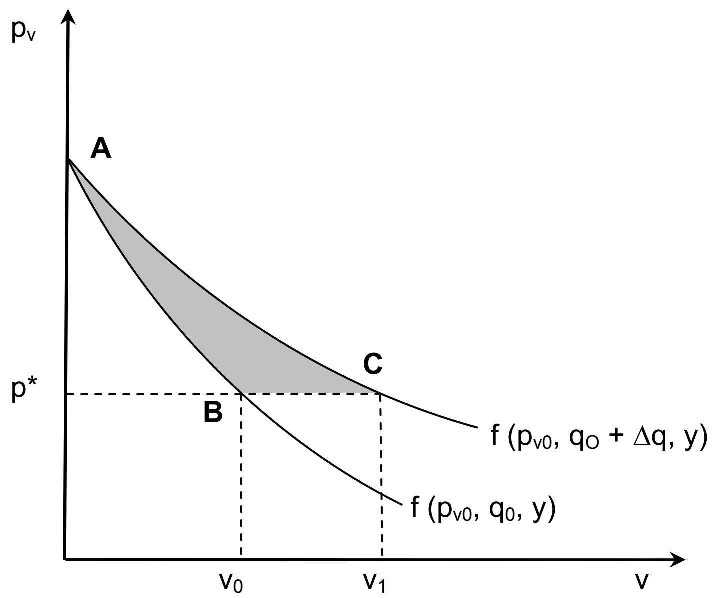
where v_0 is v estimated in equation (4) at the initial level of environmental quality ($q = 0$) and the price, $v_0 = exp(\beta_0 + \beta_1 p_v + \beta_2 y)$.

According to Alberini and Longo (2005) the change in consumer surplus associated with the proposed change in environmental quality is defined as follows:

$$\Delta CS = CS(p_{v0}, q_1) - CS(p_{v0}, q_0) = -\frac{1}{\beta_1}(v_1 - v_0) \tag{6}$$

We can consider the consumer surplus (5) to be an approximation of the welfare that is associated with a visit to the recreation site, and the welfare change (6) to be the change of recreational value in response to variation in the environmental quality. Figure 1 shows the increase in the consumer surplus (the shaded area ABC) associated with the environmental quality increase from q_0 to q_1. With the higher level of q the individual will consume more trips to the recreation site. In this situation the individual will demand visits v_1.

Figure 1: The change in consumer surplus due to the change in environmental quality



Source: Kolstad (2000)

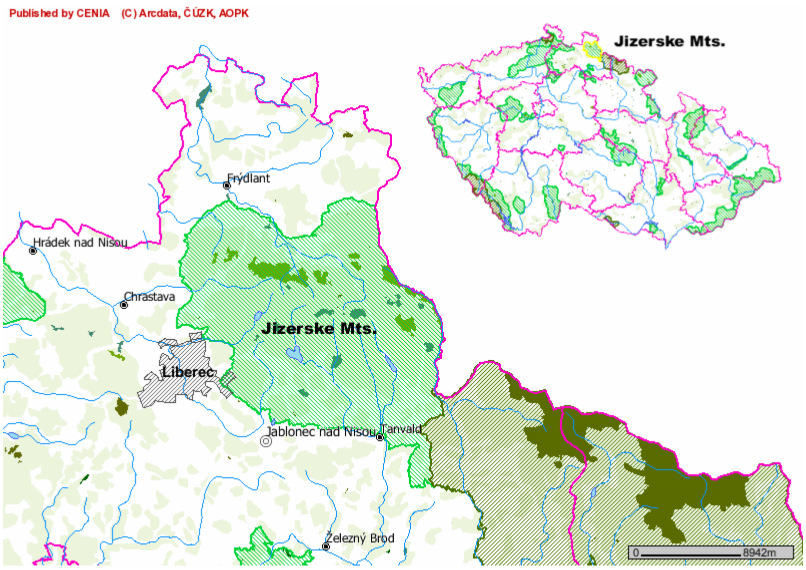
2. The study area

The Jizerske hory Mountains Protected Landscape Area was designated in 1968 and it is one of the oldest protected areas in the Czech Republic. The surface area of the PLA is approximately 368 km^2. The JH Mts. are situated in North Bohemia, close the Polish and

German borders. The geographical position of the JH Mts. is illustrated in Figure 2. Two large cities of Liberec and Jablonec nad Nisou, with a combined population of almost 190 thousand, lie near the Jizerske hory Mountains, to their southwest.

Forest ecosystems cover almost 73% of the study area (that is 270 km^2); see the right site in Figure 3. The most common wood in the JH Mts. is spruce (*Picea abies*), representing 67% of the forest ecosystems. Beech (*Fagus sylvatica*) represents 10% of the forest ecosystems.

Figure 2: Geographical position of the Jizerske hory Mts. Protected Landscape Area



Source: CENIA

Air and ground pollution, insect infestation, changes in forestry composition and intensive exploitation have been the main factors affecting the quality of the forest ecosystems, mainly the spruce.

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The air pollution sources are situated in Germany and Poland. Substantial SO_2 emissions have been produced by electricity generation in the power plants of Hagenwerder I, II, III, Hirschfeld, Boxberg (Germany), and Turoszow (Poland)[3]. These same sources also release fluorine. Road traffic is another source of air pollution, having a major share in the NO_X pollution loads. The high concentrations of these pollutants influenced the quality of forest in the JH Mts. between 1976 and 1990. The forest ecosystems, mainly the spruce, located in the

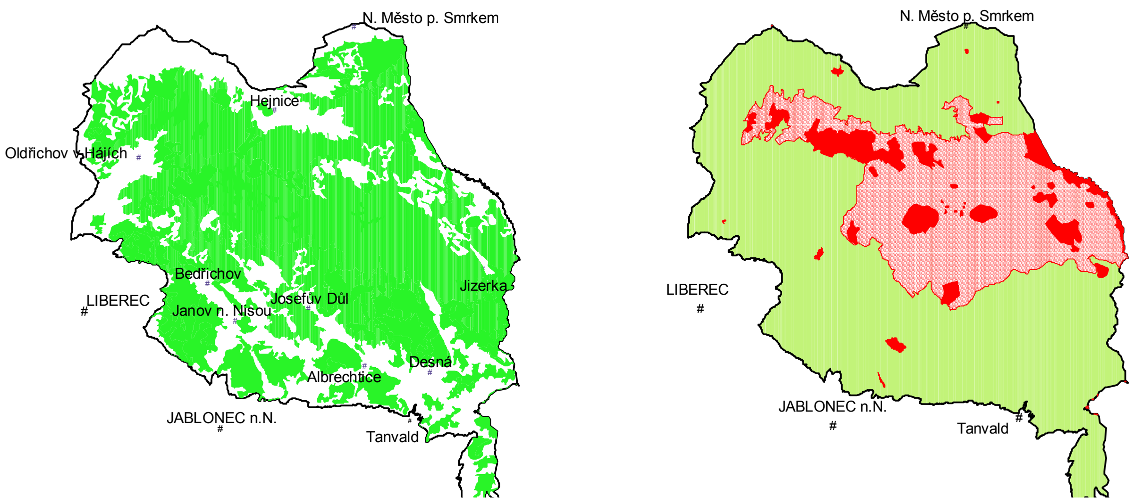
[3] Electricity generation at Hagenwerder I and Hirschfelde ended in 1992.

central part of the study area have been totally destroyed. Approximately 60 km^2 of the area has been deforested. In the early 1990's the production of emissions decreased significantly, but atmospheric deposition rates are still high at some places in the JH Mts. Nowadays 68% of the spruce wood is defoliated and damaged.

Mountain bark beetle was another factor that influenced the forest ecosystems in the JH Mts. The largest bark beetle calamity occurred in 1982-1985. Favorable climate conditions as well as the spruce wood having been weakened by pollution caused a very rapid gradation of the bark beetle counts in that period.

Windy conditions, hoarfrost, deer game, soil erosion, and changes in forestry composition have been other negative factors influencing the forest quality in the past.

Figure 3: Geographical positions of forest ecosystems and Natura 2000 sites in the JH Mts.



Above all, beech forest, peat coenosis, mountain pine forest, and herb-rich and waterlogged meadows are subject to strictest protection in small-scale conservation areas (3 national nature reserves, 13 nature reserves, and 8 nature monuments). Under European Commission directives , Natura 2000 preservation areas were defined and designated in the JH Mts. A bird area was proposed for two endangered bird species: the black grouse (*Tetrao tetrix*) and the little owl (*Aegolius funereus*). Additional 7 natural habitat localities were proposed for protection within the Natura 2000 network in the JH Mts.; see the left site in Figure 3.

The JH Mts. are also a favorite destination for summer and winter recreational activities such as hiking, mountain biking, cross-country skiing, and downhill skiing.

3. Sampling strategy and survey design

The sampling plan

In order to apply the single site travel cost model, which relies on observed behavior of individuals, relevant information has to be obtained from visitors to the recreation site. Individual data are usually obtained by administering a survey. Therefore, a questionnaire that queried respondents about their current visit to the JH Mts., travel mode and attitudes was constructed. The survey on the JH Mts. was conducted from May to October 2005.

The first monitoring of the recreation site was carried out during May and June. Forest ecosystems of different air pollution impacts and species composition were determined and 19 forest stands were selected for applying a scenic beauty estimation method (SBE)[4]. According to the SBE method, sets of photographs of the forest sites were acquired and then tested on several focus groups (n = 22 respondents).

A preliminary test was carried out during June and July. Several in-depth interviews were made with visitors and the pilot version of the questionnaire was prepared. Four pilot surveys (around 50 respondents in each pilot) were carried out in August in order to improve and finalize the questionnaire and to test the sampling strategy in the field.

The final survey was conducted during September and October. The questionnaire was administrated on-site to visitors at four sites located in the central part of the Jizerske hory Mts. Respondents were intercepted randomly and interviewed by trained interviewers face-to-face on each of these four sites. Interviewing began early on the day, and respondents were selected randomly throughout the day. The survey resulted in a total of 312 completed questionnaires.

Visitors doing summer recreational activities such as hiking and mountain biking in the central part of the JH Mts. were the target population of the survey. These individuals had immediate experience with the different quality of forest that they observed on their trips. They were able to rate the forest stands presented to them in the photographs.

The questionnaire

The questionnaire was designed and pre-tested for ease of responding. The questionnaire was proposed to allow interviews to be completed in 15 minutes in order to avoid the respondent's fatigue.

[4] The application of SBEM is reported in Brown (1987), Brown and Daniel (1986), Brown and Daniel (1984).

The questionnaire was divided into four thematic sections. The first section collected information about the respondent's visit to the JH Mts. and his/her recreational activity. The respondent was asked about the frequency of his/her visits to the site as the number of trips over the last 12 months. The respondent had to classify the number of trips made over the last 12 month according to the season and length of trip. He/she was also asked about information relevant to the current trip. The respondent was inquired about the motivation of the present trip, the mode of transport to the site, the type of recreational activity, the number of persons in the respondent's group and the length of the trip in kilometers on foot or by bike. If the respondent was/had been staying overnight at the recreation site, he/she was asked about the number of nights spent on the site and the type of accommodation.

Information about the cost of the trip was also inquired about. The respondent was asked about the cost of transport and with how many people they shared the cost. If the respondent had arranged accommodation we inquired about the cost of the accommodation. A substitute recreation site was also inquired about.

The second section of the questionnaire was focused on rating 9 color pictures showing different qualities of forest sites. First, the respondent examined if he/she had experienced the presented type of forest on the current trip. Then he/she rated the aesthetical quality of each forest stand on a scale of 1 to 5, where 1 means the best possible quality and 5 means the worst possible quality. The next question was focused on rating (also on a scale of 1 to 5) the health status of all forests in the JH Mts. according to the respondent's experience.

Next, four hypothetical programs that would improve or impair the environmental quality of the site were proposed in this section of the questionnaire. The hypothetical scenarios are described in Appendix 1, Figures 4-6.

(i) A decline in the forest quality was proposed in the first hypothetical scenario. 70% of the spruce wood would be seriously damaged in the near future by continuing air pollution.

(ii) In the second scenario a change of forestry composition was suggested. The management of the PLA would plant broad-leaved trees, which are more resistant to air pollution than spruce wood. 80% of the area would be covered by broad-leaved trees.

(iii) Designation of a bird area within the Natura 2000 network which would cover 40% of the area was the third scenario. The purpose of the bird area was to protect and increase the populations of two endangered bird species: the black grouse and the little owl.

(iv) In the fourth scenario an entrance fee into the bird area was proposed. The fee would amount to CZK 30 per person per day[5].

The respondent was asked if he/she would enjoy the site more or less and how more or less often he/she would visit the site if the hypothetical scenarios were implemented.

In the third section the socio-economic information about the respondent was collected. The fourth section contained debriefing questions for the respondent and also for the interviewer.

4. Sample characteristics

Characteristics of trips

Six per cent of the respondent sample had come to the JH Mts. for the first time. The frequency of visits on one-day and more-day trips was inquired about for each season over the past 12 months, i.e. autumn 2004, winter 2005, spring 2005, and summer 2005. For more-day trips the number of days spent in total in the JH Mts. was also inquired about. A histogram of the numbers of trips is shown in Figure 7.

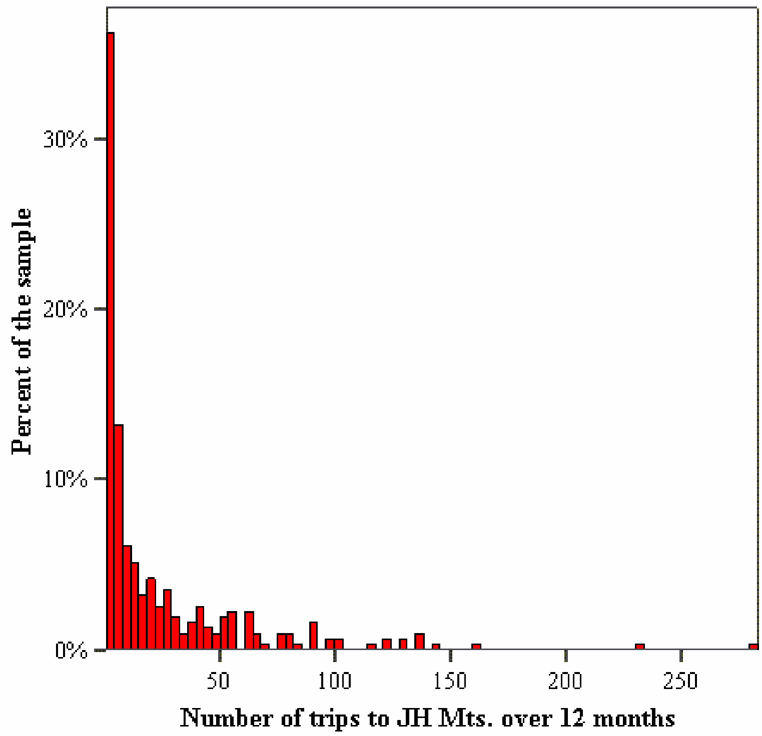
The average number of annual trips to the JH Mts. is 24.42 with a median value of 9. More than 13% of the sample made only one trip over the past 12 months. More than 36% of the sample made 1, 2, 3, or 4 trips to the JH Mts. Two persons reported exceptional rates of presence: one with 283 trips and the other with 231 trips per year.

The average number of annual one-day trips is 20.52 (the median is 3), the average number of annual more-day trips is 3.89 (the median is 1 trip). People spend 10.68 days on average per year on more-day trips. The length of the trip is more than 2 days on average (the median is 1).

Descriptive statistics about visitation patterns for each season are shown in Table 1. Most trips are made in winter and summer. The average number of one-day trips and more-day trips, respectively, made in winter is 6.47 (0.96); it is 5.85 (1.08) in summer. The maximum rates of one-day trips range from 40 to 90 trips per season.

[5] The exchange rate at the time of survey was CZK 22 per dollar.

Figure 7: Histogram of the number of trips realized to the JH Mts., n = 312



Approximately 55% of the respondents were on a one-day trip to the JH Mts. when interviewed. More-day trips composed the rest of the sample.

Table 1: Structure and frequency of visits to the JH Mts., n = 312

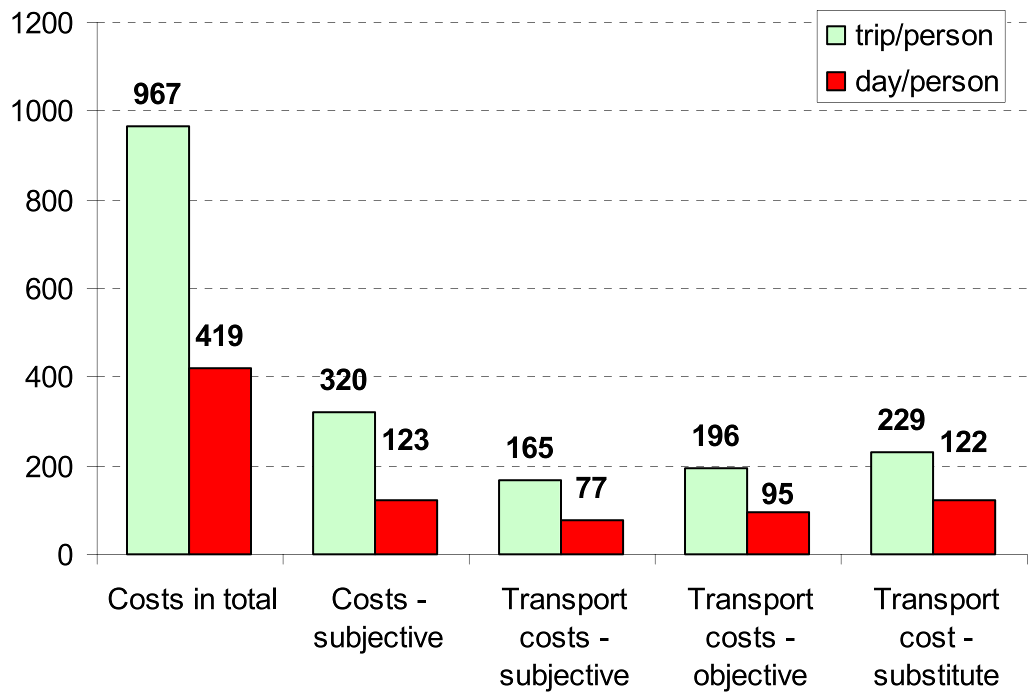
	Mean	Median	Std. dev.	Minimum	Maximum
Summer – one-day trip	5.85	0.5	11.31	0	90
Summer – more-day trip	1.08	0	2.79	0	24
Summer – days spent on more-day trip	2.97	0	7.27	0	50
Spring - one-day trip	3.75	0	8.52	0	90
Spring - more-day trip	0.68	0	2.33	0	24
Spring - days spent on more-day trip	1.65	0	5.25	0	48
Winter - one-day trip	6.47	0	12.95	0	90
Winter - more-day trip	0.96	0	2.85	0	24
Winter - days spent on more-day trip	2.62	0	6.56	0	48
Autumn - one-day trip	3.90	0	7.44	0	40
Autumn - more-day trip	0.73	0	2.37	0	24
Autumn - days spent on more-day trip	1.87	0	5.40	0	48

The total average cost spent on a trip per person was CZK 967, as shown in Figure 8. The costs included transport costs, accommodation costs[6], and opportunity costs of time. The median value is CZK 550, and the maximum is CZK 6,817. Expressed per person per day, the costs amount to CZK 419, while the median value is CZK 350.

Subjective costs, i.e. the costs which were stated directly by the respondents, were CZK 320 on average per trip per person, and CZK 123 per day per person. The transport costs, one component of the subjective costs, were CZK 165 on average per trip per person, and CZK 77 per day per person.

Objective transport costs were also measured and compared with the subjective transport costs. The MapPoint software was used to estimate road distances as well as fuel costs for each respondent. The objective costs were estimated for transport to the JH Mts. as well as for transport to substitute recreation sites. The costs of transport to the JH Mts. were CZK 196 on average per trip and person, and CZK 95 per day per person. The transport costs to the substitute sites were higher on average: CZK 229 per trip per person.

Figure 8: The total costs, subjective and objective costs of a trip to the JH Mts., n = 312

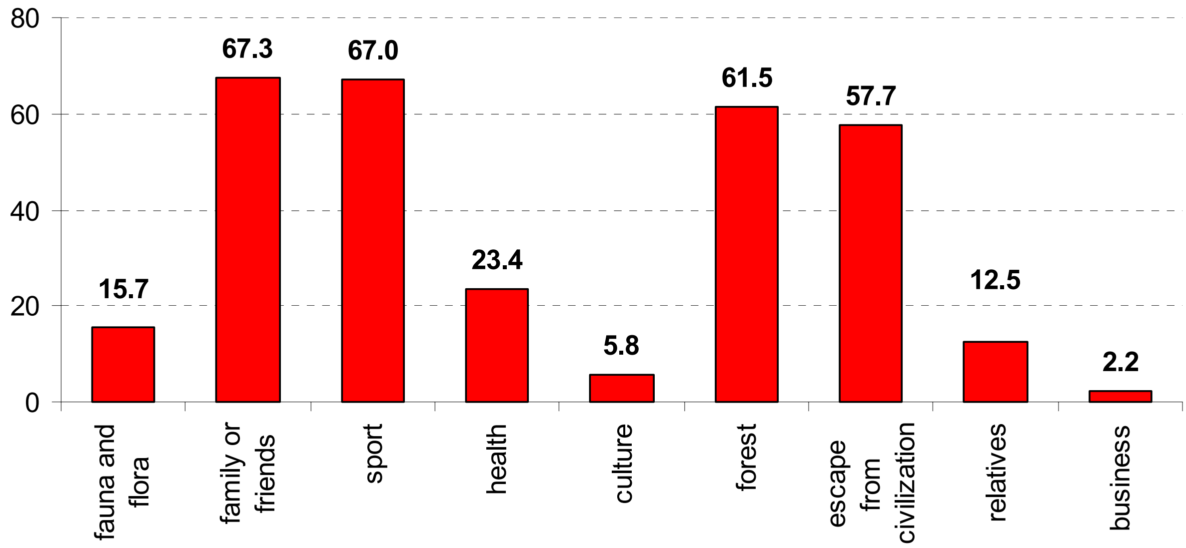


[6] The costs of transport and accommodation are subjective costs that were stated directly by the respondent in the questionnaire.

Most of the visitors came by car: 80.1 % of the more-day visitors traveled to the study site by car, 12.7 % of respondents went by train, and 7% traveled by bus. During their stay in the JH Mts. they used the car rarely: in 21.2% of the cases; train in 2.8%, and bus in 2.1%. Most used the bicycle (64.5%) or walked (58.1). One-day trippers traveled by car in 45%. 8.1% traveled by bus and 7% used trains. 56.1% of one-day trippers went by bicycle, and 47.9% walked.

The questionnaire also inquired about the motives for visiting the JH Mts.; see Figure 9. Family/friends and sports occurred as a motive for visiting the recreation site in 67.3% and 67% respectively. Visitation of forests and a getaway from the civilization were other important motives (61.5% and 57.7% of the sample respectively). Health (23.4%) and fauna and flora (15.7%) were the less important motives.

Figure 9: Respondents' motives for visiting the JH Mts., n = 312



In terms of the recreation activity type on the current trip, 56% of the respondents were mountain bikers, the rest were hikers. The average size of a group was 3.5 persons. The average number of children in a group was 0.5 children. The maximum size of a group was 50 persons.

The substitute sites most frequently given by respondents were the Krkonoše Mountains (24%), the Český ráj Hills (21%), the Šumava Mountains (16%), and the Lužické hory Mountains (9%).

Table 2 shows the trip length structure. Almost 60% of the respondents made a trip of 16 to 50 km, which indicates the visitors' fitness.

Table 2: Trip length during the current visit to the JH Mts., n = 312

Trip length	%
0 - 5 km	3.85
6 - 10 km	9.94
11 - 15 km	13.46
16 - 20 km	13.46
21 - 30 km	18.91
31 - 40 km	10.90
41 - 50 km	14.42
51 - 60 km	7.37
61 - 70 km	2.88
71 km and more	4.81

Perception of the forest and the contingent behavior scenarios

The respondents rated the quality of forest ecosystems in the JH Mts. on a scale of 1 to 5. Figure 10 illustrates that the visitors found the forests not so badly damaged. Moderate damage was expressed by 53%, and slight damage by 36% respondents. Only 9% of the sample perceived the forests as heavily to completely damaged.

Figure 10: Rating of the quality of forest ecosystems by respondents in the JH Mts, n = 312

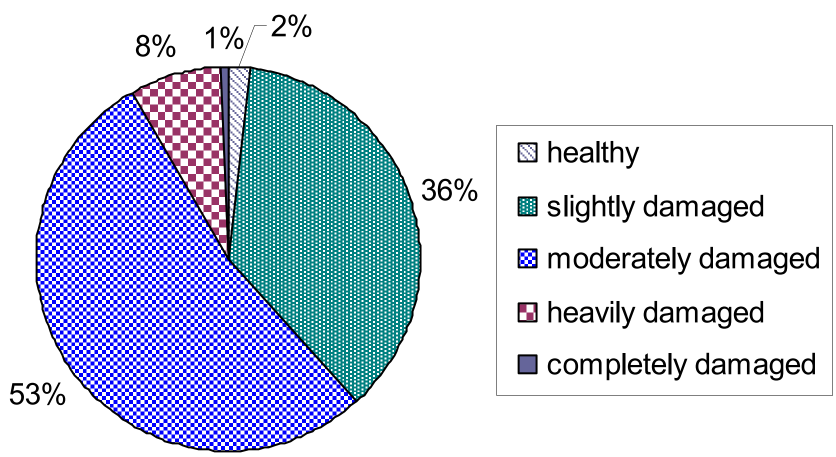


Table 3 presents the structure of the responses to the hypothetical situations in relation to enjoyment and number of trips. The majority of the respondents (83%) believed that in response to the implementation of the first program, i.e. 70% complete destruction of the spruce woods, their enjoyment from recreation in the JH Mts. would decrease. The rest of the respondents would have the same experience. 42% of the visitors stated that they would visit the site less often and 57% would not change the frequency of their visits.

If the second program was implemented, i.e. 80% of the area would be covered by broad-leaved trees, 34% of the respondents believed that their enjoyment would increase. 50% would have the same experience and 16% believed that their enjoyment would decrease. 11% of the visitors expressed that they would visit the JH Mts. more often, 5% would decrease their visitation rates.

In response to the designation of a bird area and an increase in the bird population, 45% of the respondents believed that their enjoyment would increase. The rest of the respondents would have the same experience. 17% of the visitors stated that they would visit the site more often and the rest reported that they would not change the frequency.

If an entrance fee were implemented in the JH Mts., 24% of the respondents would visit the site less often. 74% of the visitors would not change the frequency of their trips.

Table 3: The structure of responses to hypothetical questions, in %, n = 312

	N (valid)	increase	equal	decrease
Change in enjoyment				
Spruce	309	0.32	17.15	82.52
Broad-leaved trees	308	34.09	49.68	16.23
Natura 2000	309	44.66	55.02	0.32
Change in number of trips				
Spruce	307	1.30	57.00	41.69
Broad-leaved trees	299	11.04	83.95	5.02
Natura 2000	304	17.11	82.89	-
Entrance fee	310	1.29	74.52	24.19

Socio-economic characteristics of the respondents

The majority of the respondents (47%) were residents of the Liberecký Region, in which the JH Mts. are situated. Almost 30% of the sample came from Prague, the capital of the Czech Republic. The JH Mts. can be reached very easily from the capital by approximately a one hour's drive on a motorway. 27% of the respondents came from Liberec (the capital of the Liberecký Region) and 10% from Jablonec nad Nisou, the cities close to the JH Mts.

More than 57% of the interviewed were male. The average age was 40 years, which is close to the medial value of 39 years. The minimum age was 18 and the maximum age was 84; see Table 4. The average household size was 2.8 persons, the median value was 3 persons. The maximum household size was 7 persons. The number of children per household was very low: the average was 0.5 child per family. The maximum was 5 children.

Table 4: Age and household size, n = 312

	Household size	Number of children	Age
N	311	311	311
Mean	2.81	0.51	40.11
Median	3	0	39
Minimum	1	0	18
Maximum	7	5	84

The sample is highly educated as almost 51% of the respondents have secondary education, and 37.5% have a university degree. The majority of the respondents were married (47%), 37% of them were single.

The economic status of the respondents is as follows. The majority, 60%, have full-time jobs; 15% are businesspeople, 8% are retired, and 6% are students. The average net individual income is 17 thousand CZK per month and the average net household income is 31 thousand CZK per month.

5. Econometric models and welfare estimates

Econometric models

As one can see in Figure 7, the number of trips to the JH Mts. made over the past 12 month is proportionate to a model using a Poisson distribution, see e.g. Alberini, Longo (2005). The number of trips is a count data variable which can be denoted as Y. If we follow Haab and McConnell (2002), then the probability function for Y could be expressed as:

$$\Pr(Y = y) = \frac{e^{-\lambda}\lambda^{y}}{y!} \tag{7}$$

where the parameter λ is the expected number of trips and is a function of independent variables specified in the model. The expected value and the variance of Y are equal to λ. The number of trips is the non-negative integer variable and therefore λ usually takes a log linear form:

$$\lambda_{ij} = exp(\boldsymbol{x}_{ij}\, \boldsymbol{\beta}_1 + p_{ij}\beta_2 + q_j\beta_3) \tag{8}$$

where $\boldsymbol{x}$ is a vector of socio-economic variables and other variables determining the trip to the JH Mts. p_{ij} are the travel cost spent by the respondent ($i = 1, 2, ..., n$) on the trip. q_j is a dummy variable indicating the presence of the hypothetical scenarios. $\boldsymbol{\beta}_1$, β_2 a β_3 are unknown parameters.

The parameters in equation (8) are estimated using a maximum likelihood method. Using equation (7) and (8) the probability of observing the number of trips is estimated for each person in the sample. As Parsons (2003) suggests, the likelihood function becomes:

$$L = \prod_{n=1}^{n} \frac{e^{-\lambda_n} \lambda_n^{y_n}}{y_n!} \tag{9}$$

The on-site sample which was realized in the JH Mts. is truncated to one trip, and also the more frequent users occur in the sample. To correct the probability function we replace y_n by y_n-1 in the basic Poisson function (7), see also Parsons (2003) and Haab and McConnell (2002). Then the function assumes the following form:

$$\Pr(y_n \mid y_n > 0) = \frac{e^{-\lambda_n} \lambda^{y_n - 1}}{(y_n - 1)!} \tag{10}$$

Then equation (10), instead of (7), enters the likelihood function for each individual.

When using the Poisson distribution, we assume that the expected value and the variance of Y are equal to λ. For recreational trip data, the variance is usually higher than the conditional mean, causing overdispertion in the data. The consequence of overdispersion is the fact that the standard errors in the case of the Poisson model are underestimated (Haab and McConnell, 2002). The negative binominal regression model addresses the failure of the Poisson model by adding a parameter, α, that reflects unobserved heterogeneity among observation. The negative binominal distribution assumes the following form (see e.g. Haab and McConnell, 2002):

$$\Pr(y \mid x) = \frac{\Gamma(y+\alpha^{-1})}{y!\Gamma(\alpha^{-1})}\left(\frac{\alpha^{-1}}{\alpha^{-1}+\lambda}\right)^{\alpha^{-1}}\left(\frac{\lambda}{\alpha^{-1}+\lambda}\right)^{y} \quad (11)$$

Where *Γ()* is the gamma function. The expected value of the negative binominal distribution is equal to λ. However, the variance of the dependent variable is $V = \lambda\ (1 + \alpha\ \lambda)$. The parameter is the overdispersion parameter. If $\alpha = 0$, no overdispersion exists. But if $\alpha > 0$, then overdispersion exists and the Poisson model is rejected in favor of the negative binominal distribution.

The dependent variable and the selection of independent variables

The dependent variable in the model is the number of trips to the JH Mts. made by the respondent over the past 12 months. Figure 7 illustrates the distribution of this variable denoted in the model as TRIPS. Using the contingent behavior model, each respondent contributes five observations to the sample, the actual and hypothetical number of visits.

The vector ***x*** has the following variables:

(i) The dummy variables SPRUCE, LEAF, NATURA, FEE which are related to the hypothetical scenarios. The value of the dummies is equal to zero when the observation on trips refers to actual trips.

(ii) The travel costs of the visit are expressed per trip per person. The travel costs (COSTS) include the costs of transport and accommodation stated by the respondent. The opportunity costs of time are not included (see the note 7 bellow). Thus, the results could be biased downwards.

(iii) The next variable is the respondents' economical status, ECONOM, which is a dummy variable. If the value of the dummy is 1, the respondent has a full-time job or is a businessperson.

(iv) The variable AGE determines the respondent's age.

(v) The variable INCOME represents the net monthly individual income.

(vi) UNIVER is a dummy variable that represents the respondent's level of education. If the value of the dummy is 1, the respondent has a university degree.

(vii) The length of the trip in kilometers is another variable named LENGTH.

Actual visitation rates: Results

In the first run the number of actual trips made by the respondent was used to fit into the equation (7), (10) and (11). The total sample size in this case is 311 observations. The results were estimated using a maximum likelihood method by means of SAS 9.1 software, and they are reported for the Poisson model (PM), the truncated Poisson (TPM) and the truncated Negative Binominal (TNB) in Table 5. The coefficient of the cost variable is significant in these models and negative according to the economic theory. Its magnitude is -0.0026 (PM), -0.0027 (TPM) and -0.0008 (TNB). There is significant evidence of overdispersion (we can reject H_0: $\alpha = 0$), the negative binominal regression model is preferred to the Poisson model.

The numbers of trips also increase with the respondents' age. The numbers of trips tend to be greater among visitors with full-time jobs or businesspeople (significant in PM and TMP). The length of the trip also has a positive influence on the number of trips to the JH Mts. Education status and individual income are without effect on the dependent variable.

Table 5: Maximum likelihood estimation of the actual visits, single site Poisson model, Truncated Poisson and Truncated Negative Binominal, n = 311

	Poisson model		**Truncated Poisson**		**Truncated Negative Binominal**	
Parameter	**Estimate***	**S.E.**	**Estimate***	**S.E.**	**Estimate***	**S.E.**
costs	-0.0026	0.0001	-0.0027	0.0001	-0.0008	0.0001
age	0.0164	0.0009	0.0164	0.0009	0.0185	0.0063
econom	0.3155	0.0307	0.3133	0.0308	0.2871	0.2191
length	0.0114	0.0006	0.0115	0.0006	0.0150	0.0055
Intercept	2.3195	0.0536	2.3297	0.0537	1.5596	0.3636
Log-likelihood	-4512.89		-4478.79		-1209.98	
LR chi2(4)	3816.50		3884.71		51.10	
N	311		311		311	
alpha					0.9823	

Likelihood-ratio test of alpha = 0: chibar2(01) = 6605.821 Prob>=chibar2 = 0

*All coefficient except econom variable in truncated NB are different from zero at the 95% level of confidence.

The average consumer surplus associated with an access to the JH Mts. under the current conditions is CZK 9,569 for PM, CZK 9,060 for TPM and CZK 30,249 for TNB. Expressed in US dollars the average consumer surplus per trip is about USD 18 for PM, USD 17 for TPM and 56 for TNB[7]. This recreation values are comparable to other travel costs studies, except truncated Negative Binominal Models that generates more than double estimates.

Combining actual and hypothetical observations: Results

[7] The exchange rate at the time of survey was CZK 22 per US dollar.

To estimate the value of the hypothetical programs that influence the environmental quality of the JH Mts. we have to combine the actual and contingent behavior trips. Pooling these trips we arrive at 1,244 observations. The results are reported in Table 6.

Table 6: Maximum likelihood estimation of the actual and contingent visits, truncated Poisson single site model, n = 1 244

Variable	coefficient	standard error	confidence interval	
Intercept	2.2415	0.0291	2.1845	2.2985
COSTS	-0.0028	0	-0.0029	-0.0027
AGE	0.0161	0.0005	0.0152	0.017
ECONOM	0.3933	0.0167	0.3605	0.4261
LENGTH	0.0117	0.0003	0.0111	0.0123
SPRUCE	-0.9524	0.032	-1.0152	-0.8896
Log likelihood	64 386			

As shown in Table 6, the coefficients of the basic variables are approximately the same as in the Poisson and truncated Poisson model. The coefficient of the cost variable is significant and negative. Its magnitude is -0.0028. The other socio-economic variables (age and economic status) and the length of trips are significant and have a positive influence on the annual number of visits.

The key variables for placing a monetary value on a change in environmental quality are the dummies corresponding to the hypothetical scenarios. As shown in Table 6, the only scenario with a significant influence on the number of trips is the program affecting the quality of the spruce wood. As expected, its coefficient is negative. The other scenarios are without significant impacts on the visitation rate.

The average consumer surplus per access associated with the new conditions is CZK 6,480. Its minimum value and maximum values are CZK 6,062 and CZK 6,711, respectively. The average consumer surplus expressed in US dollars is about USD 295.

If the spruce wood scenario were implemented, the welfare change would decrease by about CZK 1,574 on average over the sample. The change ranges from CZK 1,072 to CZK 1,630. The corresponding average value of the change in US dollars is USD 71. If we express the welfare change per trip and person we come to the value of CZK 67, i.e. about USD 3.

6. Discussion and conclusions

The travel cost study was conducted for the purpose of placing a recreation value on the area of the Jizerske hory Mountains. The welfare change associated with implementing the hypothetical scenarios which would influence the environmental quality of the site was also computed. The study gathered information about trips, attitudes and motivations of the visitors who came to the Jizerske hory Mountains. The questionnaire was designed and completed with the visitors who were intercepted on the site. The survey was conducted in September and October 2005, and resulted in a total of 312 completed questionnaires.

The questionnaire included questions about the characteristics of the current visit, the visitation rate in the past year, and contingent behavior questions. Respondents were also queried about a number of factors related to nature protection, scenic beauty and quality of forest ecosystems. Finally, socio-economic information was inquired about.

In the study, the single site travel cost model was applied, which relies on both observed behaviors (the actual number of trips to a site) and stated behaviors (the number of trips that would be taken to the site under hypothetical circumstances) to infer the value of forest recreation. The travel cost method can only measure use values, and thus cannot capture non-use values.

First, the travel cost model of the actual trips to the site was estimated using the Poisson, the truncated Poisson and the truncated Negative Binominal regression model. The average consumer surplus per trip was about USD 18 for the Poisson, USD 17 for the truncated Poisson and USD 56 for truncated Negative Binominal. There was significant evidence of overdispersion that is why the negative binominal regression model was preferred to the Poisson model in this case. The problem is that recreation values estimated by truncated Negative Binominal model are more than two times higher than estimates assessed in another TCM studies. Variables such as age, economic status and length of trips were also included in these three models. They had significant positive influences on the numbers of trips.

Actual trips alone do not allow to estimate the value of the forest quality change and other public programs that would influence the visitors' experience. Therefore, the actual trips were pooled with the hypothetical trips. This yielded estimates of the value of the change in the surplus associated with the new conditions.

Only the scenario under which the quality of the spruce wood would decrease had a significant influence on the visitation rate. As expected, its coefficient was negative. The welfare change of the access value associated with this program was estimated at CZK 1,574, i.e. about USD 71. If we express the change of consumer surplus per trip we come to CZK 67 (USD 3).

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References

Adamowicz, W., Swait, J., Boxall, P., Louviere, J. and Williams, M. (1995): Perception versus objective measures of environmental quality in combined revealed and stated preference models of environmental valuation, Journal of Environmental Economics and Management, 32 (1), 52-64.

Alberini, A. and Longo, A. (2005): The value of cultural heritage sites in Armenia and sustainable tourism: evidence from a travel cost study, conference paper.

Brown, T. C. (1987): Production and cost of scenic beauty: Examples for a ponderosa pine forest. Forest Science, 33(2):394-410.

Brown, T. C. and Daniel, T. C. (1986): Predicting scenic beauty of timber stands. Forest Science, 32(2):471-487.

Brown, T. C. and Daniel, T. C. (1984): Modeling forest scenic beauty: Concepts and application to ponderosa pine. Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station.

Cragg, J. G. (1971): Some statistical models for limited dependent variables with application to the demand for durable goods. Econometrica, 39, 829-44.

Eisworth, M., Englin, J., Fadali, E. and Shaw, W. D. (2000): The value of water levels in water-based recreation: a pooled revealed preference/contingent behavior model, Water Resource Research, 36 (3), 1079-1086.

Englin, J. and Cameron, T. (1996): Augmenting travel cost models with contingent behavior data, Environmental and Resource Economics, 7 (2), 133-147.

Freeman, A.M.III. (2003): The Measurement of Environmental and Resource Values: Theory and Methods, Resources for the Future, Washington, DC, ISBN: 1-89185-362-7.

Haab, T. and McConnell, K. E. (2002): Valuing Environmental and Natural Resources: the econometrics of non-market valuation, Cheltenham: Edward Elgar.

Kolstad, C. D. (2000): Environmental Economics. Oxford University Press. New York. ISBN 0-19-511954-1.

Parsons, G. R. (2003): The Travel Cost Method. In Champ, P. A., Boyle, K. J., Brown, T. C., (eds.) A Primer on Nonmarket Valuation. London: Kluwer Academic Publishers. ISBN 0-7923-6498-8.

Walsh, R. G., Ward, F. A. and Olienyk, J. P. (1989): Recreational demand for trees in national forests. Journal of Environmental Management 28:255-268.

Walsh, R. G. and Olienyk, J. P. (1981): Recreation demand effects of mountain pine beetle damage to the quality of forest recreation resources in the Colorado Front Range. Fort Collins, CO: Colorado State University for U.S. Department of Agriculture, Forest Service (Contract No. 53-82X9-9-180), 87 p.

Ward, F.A. and Beal D. (2000): Valuing Nature with Travel Cost Models: A Manual, Edward Edgar, Cheltenham, ISBN: 1-84064-078-2.

Appendix 1

Figure 4: Hypothetical program on the change of the quality of spruce wood

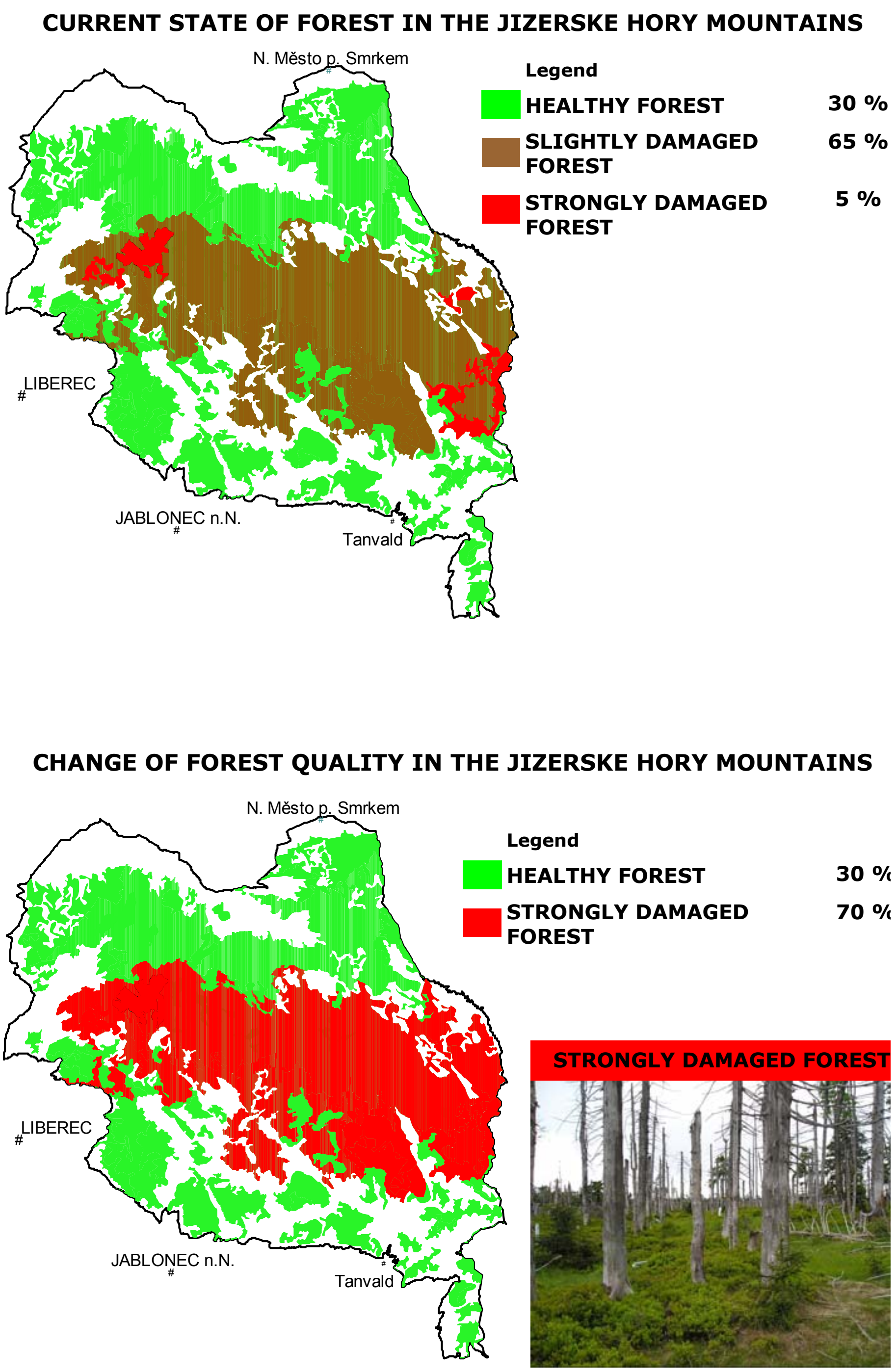
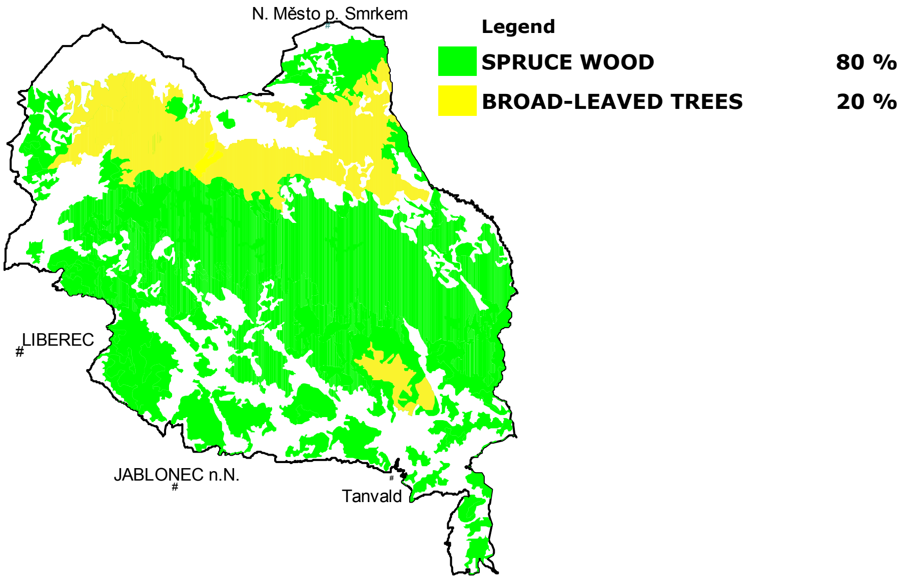


Figure 5: Hypothetical program on a change in the forest composition

FOREST IN THE JIZERSKE HORY MOUNTAINS IS COVERED



CHANGE OF FOREST COMPOSITION IN THE JIZERSKE HORY MTS.

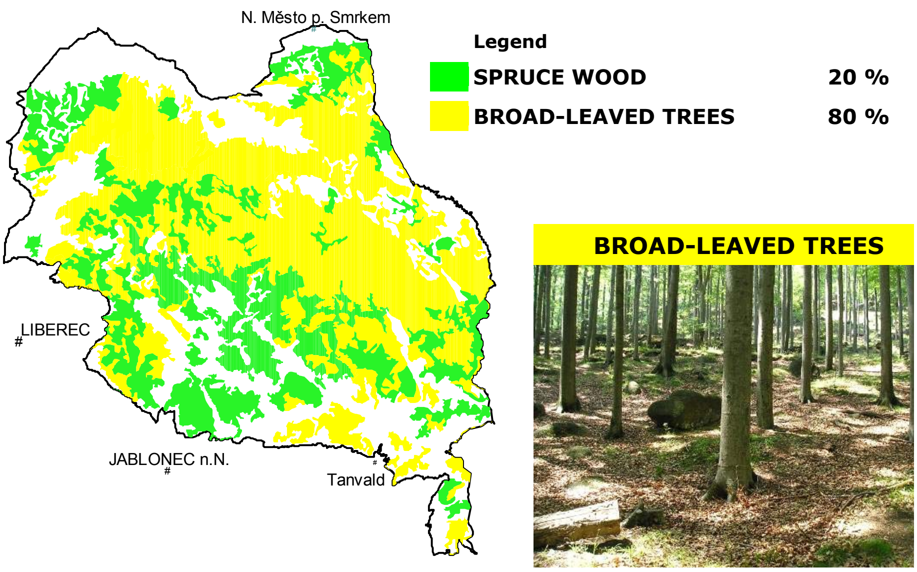


Figure 6: Hypothetical program on the designation of a Natura 2000 bird area

EXTENSION OF ENDAGERED BIRDS BY TWO TIMES

BLACK GROUSE		LITTLE OWL	
CURRENT STATE	TARGET STATE	CURRENT STATE	TARGET STATE
100 OF PAIRS	200 OF PAIRS	50 OF PAIRS	100 OF PAIRS

DECLARATION OF NATURA 2000 – BIRD AREA - IN THE JIZERSKE HORY MOUNTAINS