The economic valuation of the change of forest quality in the Jizerské hory mountains: Contingent behavior model

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The aim of non-market valuation study

- to place a recreational value associated with the summer trips to the Jizerske hory Mountains
- welfare change associated with public programs and air pollution
- combining actual trips with hypothetical trips $\Rightarrow$ contingent behavior

Problems in Jizerske hory Mts.

- Protected Landscape Area in 1968
- 70% of forest ecosystems damaged
- decrease of the forest quality

reduction in recreational and aesthetical value

Non-market valuation of forestry

Monetary values of non-timber functions not directly known

Revealed preferences | **Stated preferences**

Contingent behavior

Pooled data (Alberini et Longo, 2005)

Another possibility:

Random utility framework (Adamowicz et al., 1997)

Economic foundation of TCM

Single-site travel cost model

Weak complementarity

($\partial U/\partial q = 0$ when $r = 0$)

Utility function $U = U(X, L, r)$

Budget and time constraint

$$Y + w \cdot [T - L - r(t_1 + t_2)] = X + (f + P_d \cdot d) \cdot r$$

Demand function

$$r^* = r^*(y, w, p_r, q)$$

Economic foundation of TCM, cont.

Consumer surplus ⇒

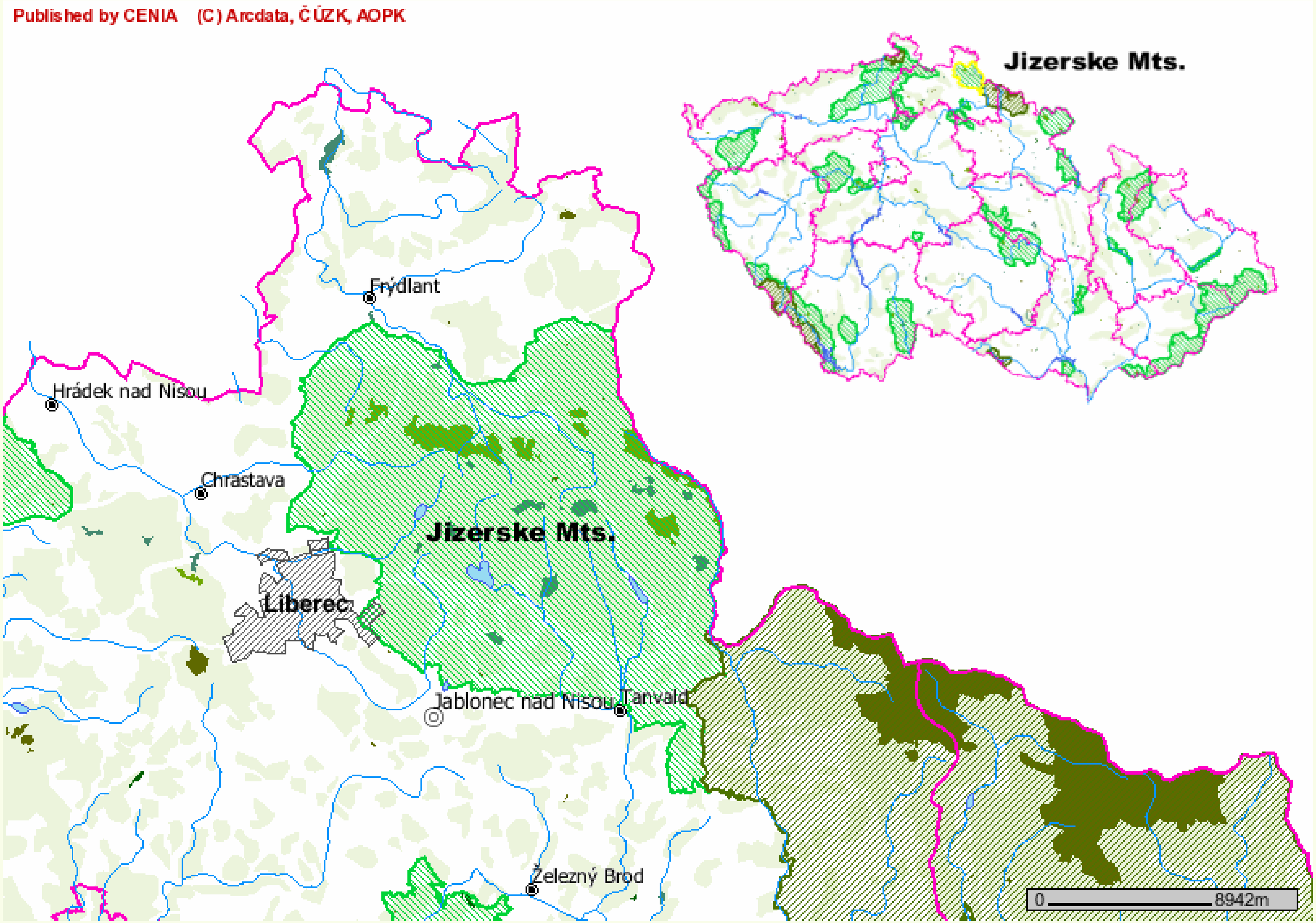
$$CS(p_0, q_0) = -\frac{1}{\beta_2} r_0$$

Change of consumer surplus

⇓

$$\Delta CS = CS(p_0, q_1) - CS(p_0, q_0) = -\frac{1}{\beta_2}(r_1 - r_0)$$

Study area – Jizerske hory Mts.



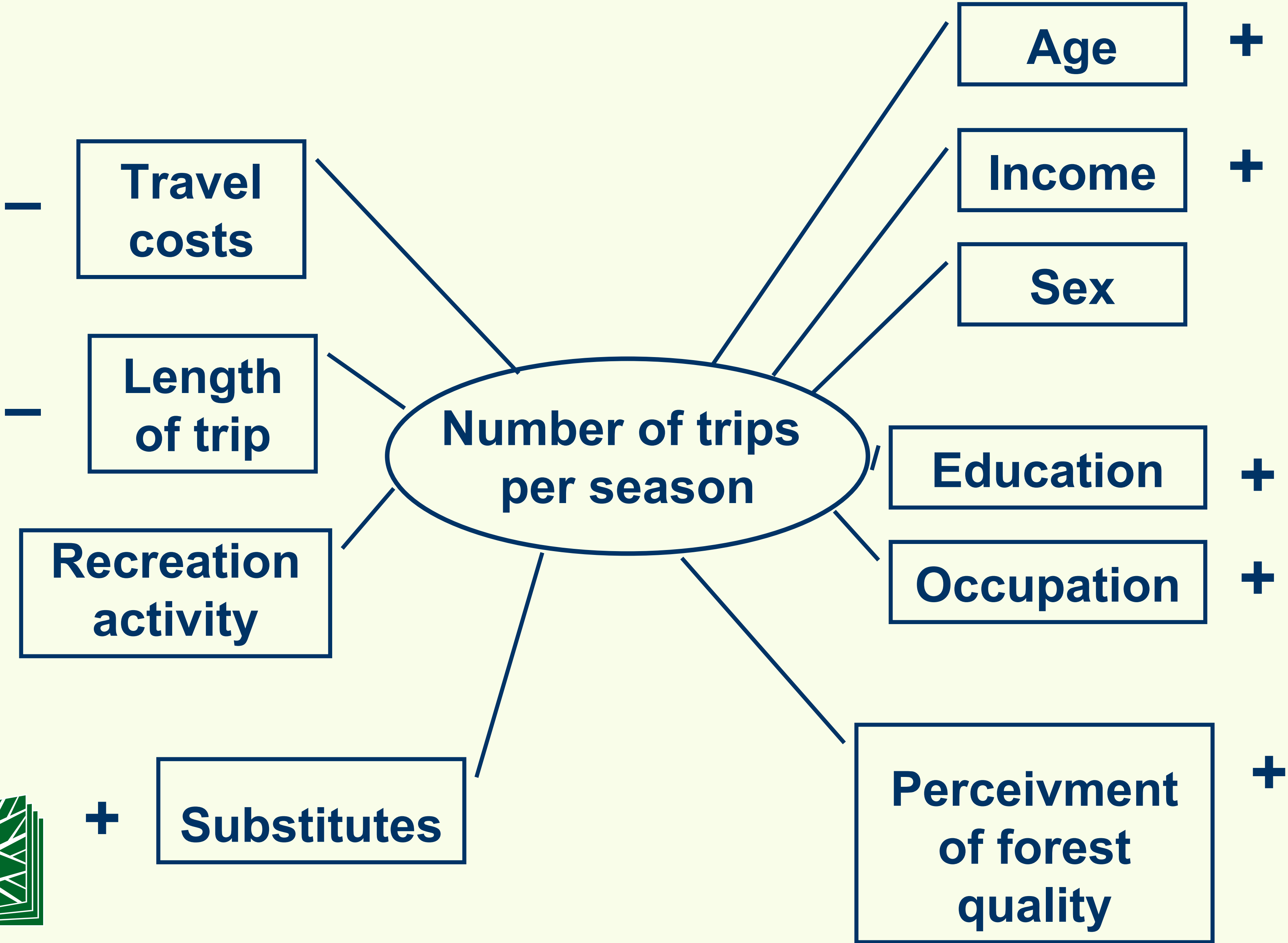
Recreation users and season

- Winter and summer recreation activities
- **Summer** activities ⇒ target population
  - hiking
  - mountain biking
- **Multiple** recreation use:
  - separate demand function
  - both type of activities ⇒ to report # trips separately
  - is the last trip the best indicator?
- **Season**:
  - May-October ⇒ final survey in Sept., Oct.
  - TCM studies ⇒ peak of summer
  - is it correct to extrapolate the respondents' characteristics on the entire season?

Sampling strategy

- **On-site sampling** (9-10/2005):
  - users intercepted at the site
  - oral survey (14 minutes)
- **Truncation:** no observation taking 0 trips ⇒ truncated at 1 trip
- **Random sample:**
  - not clear entry points
  - difficult to obtained random sample of users ⇒ 3 refreshment points, 1 observation tower
  - possible to catch mountain bikers
  - interviewing every 3 person entering the interview site
  - to sample a person as they arrive
- **Endogenous stratification**: over sample more frequent users

Specification of the model



Treatment of multiple destination and purpose trip

- **Multiple destination trip**
  - only single destination trips in JH Mts, but specific autumn period
  - how is it in the peak summer, especially in more-day trips?
  - adjustment of travel costs
- **Multiple purpose trip**
  - 2.2 % - business $\Rightarrow$ dropped from analysis, 6 % culture, 12 % relatives?

  how to handle it in the analysis?
  - day trip – all trips could be single purpose, but overnight data could be problem
  - drop multiple purpose from analysis, ask respondent to report multiple and single purpose trip separately

Measurement of the travel costs

- **Objective costs**
  - calculated by researcher ⇒ Road Map
  - in most TCM studies ⇒ only costs on fuel and upkeep ⇒ we suppose trip made by car
  - no missing estimates
- **Subjective costs**
  - expressed and perceived by respondents
  - sometimes difficult to estimate
  - or according to travel distance by car in kilometers
  - precise estimation when trip is made by bus or by train
  - cost on transport (travel, on-site) including parking fee, accommodation, number of people sharing the cost

Measurement of the travel costs, cont.

- **Travel costs on the last trip**
  - how precise is this approximation?
  - one-day and more day trips mixed during season
  - summer house residence ⇒ starting point for trip – travel costs are then expressed for one-day trip
- **Time costs**
  - time lost traveling to and from site, time spent on site
  - most studies ⇒ related to person's wage ⇒ as long as individual has flexible work
  - this breaks down in many cases ⇒ fixed jobs and retired folks, students, unemployed persons
  - wage based application – from 1/3 to full wage

Measurement of on-site time

- time on travel is more or less fixed
- but time at site is chosen by individual
- sometimes is supposed to be constant across individuals
- sometimes on-site time vary across the sample using last trip data
- on-site time is endogenous (McConnell, 1992)
- two demand equations needed, one for number of trip, the second for the length of stay ⇒ bivariate models
- one-day and more –day trips in JH Mts.

Design of the survey

I. part - information about respondent's visit

- number of trips realized over the last 12 month in each season
- information relevant to the current trip
  - motivation of the present trip
  - mode of transport
  - type of recreational activity,
  - the number of people in respondent's group
  - the length of trip
  - information about the cost of the trip

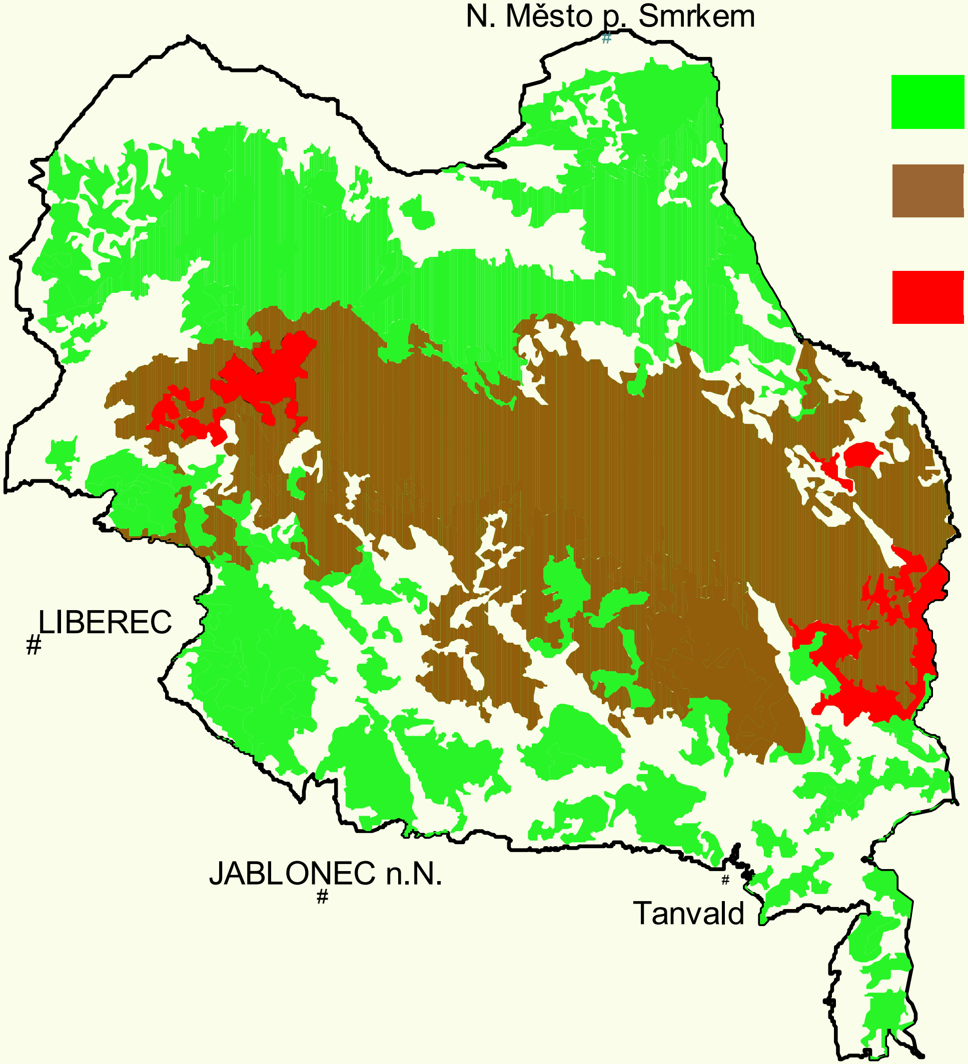
II. part – forest quality

- rating different quality of the forest stands
- four hypothetical programs improving or declining environmenta quality - how more or less often would visit this site if the hypothetical scenario will be implemented

III. part - socio-economic information

IV. part - debriefing questions

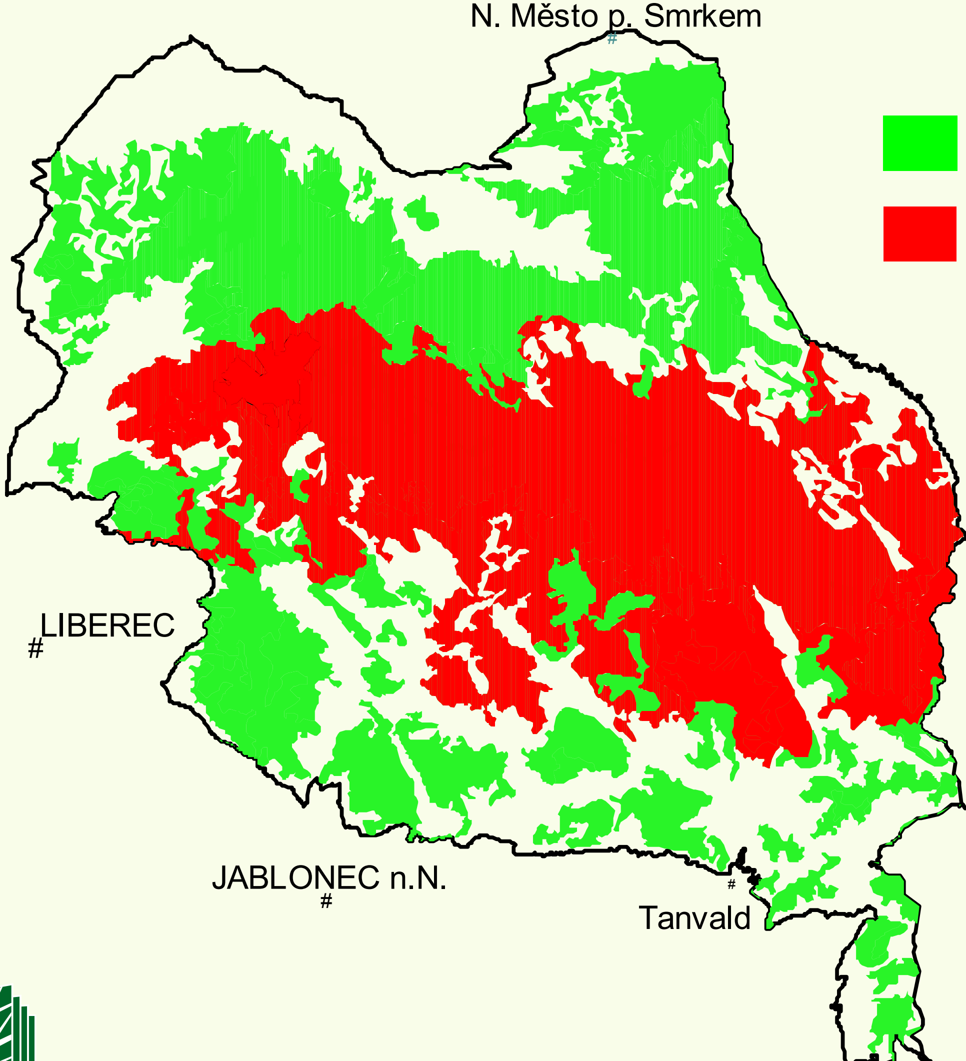
CURRENT STATE OF FOREST IN THE JIZERSKE HORY MOUNTAINS



Legend

	HEALTHY FOREST	30 %
	SLIGHTLY DAMAGED FOREST	65 %
	STRONGLY DAMAGED FOREST	5 %

CHANGE OF FOREST QUALITY IN THE JIZERSKE HORY MOUNTAINS

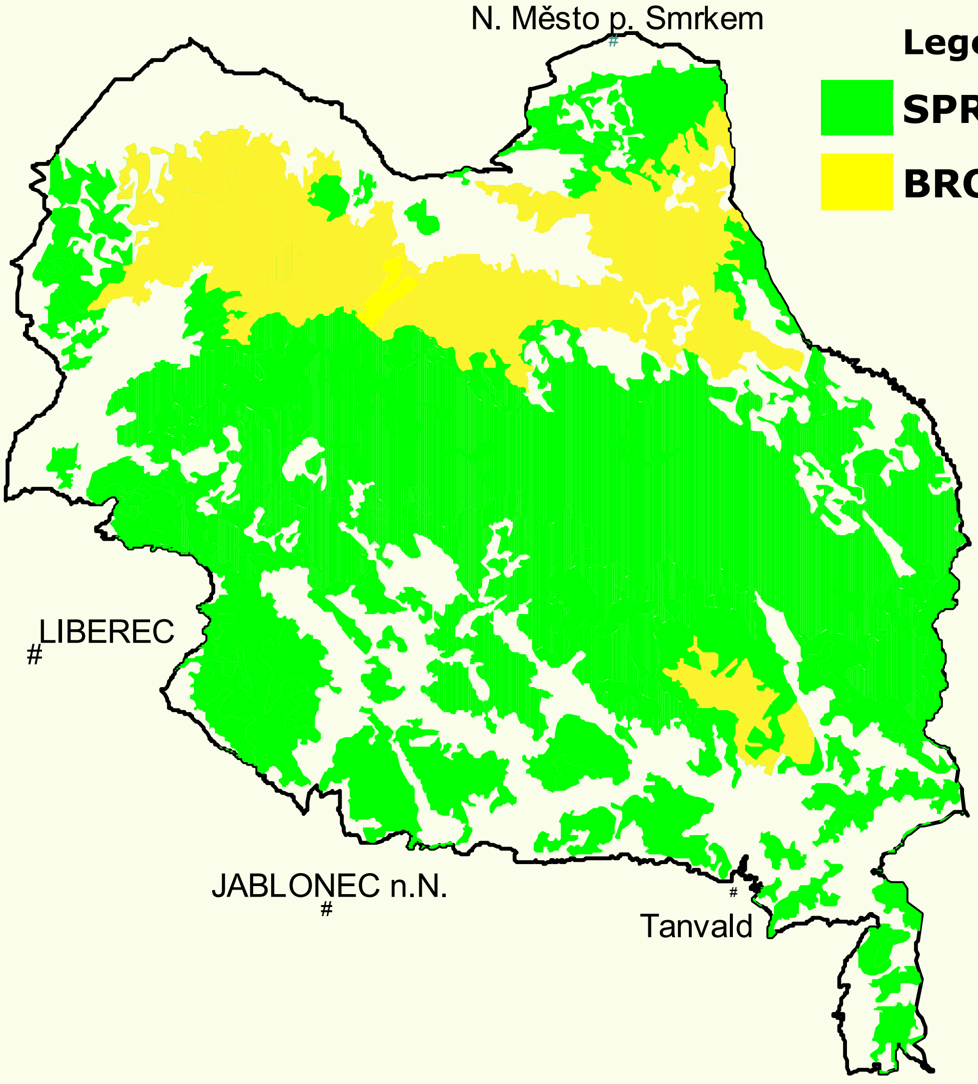


Legend

(green)	**HEALTHY FOREST**	**30 %**
(red)	**STRONGLY DAMAGED FOREST**	**70 %**

STRONGLY DAMAGED FOREST

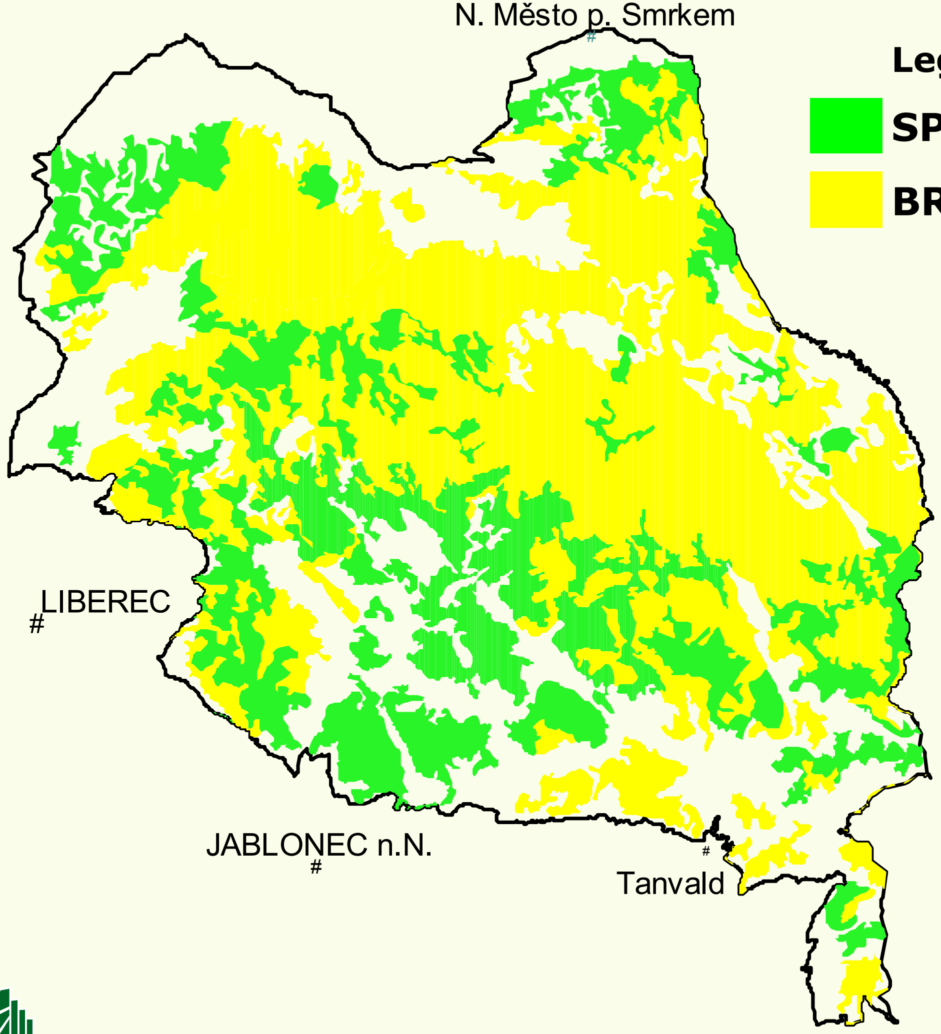
FOREST IN THE JIZERSKE HORY MOUNTAINS IS COVERED



Legend

	SPRUCE WOOD	**80**
	BROAD-LEAVED TREES	**20**

CHANGE OF FOREST COMPOSITION IN THE JIZERSKE HORY MTS.



Legend

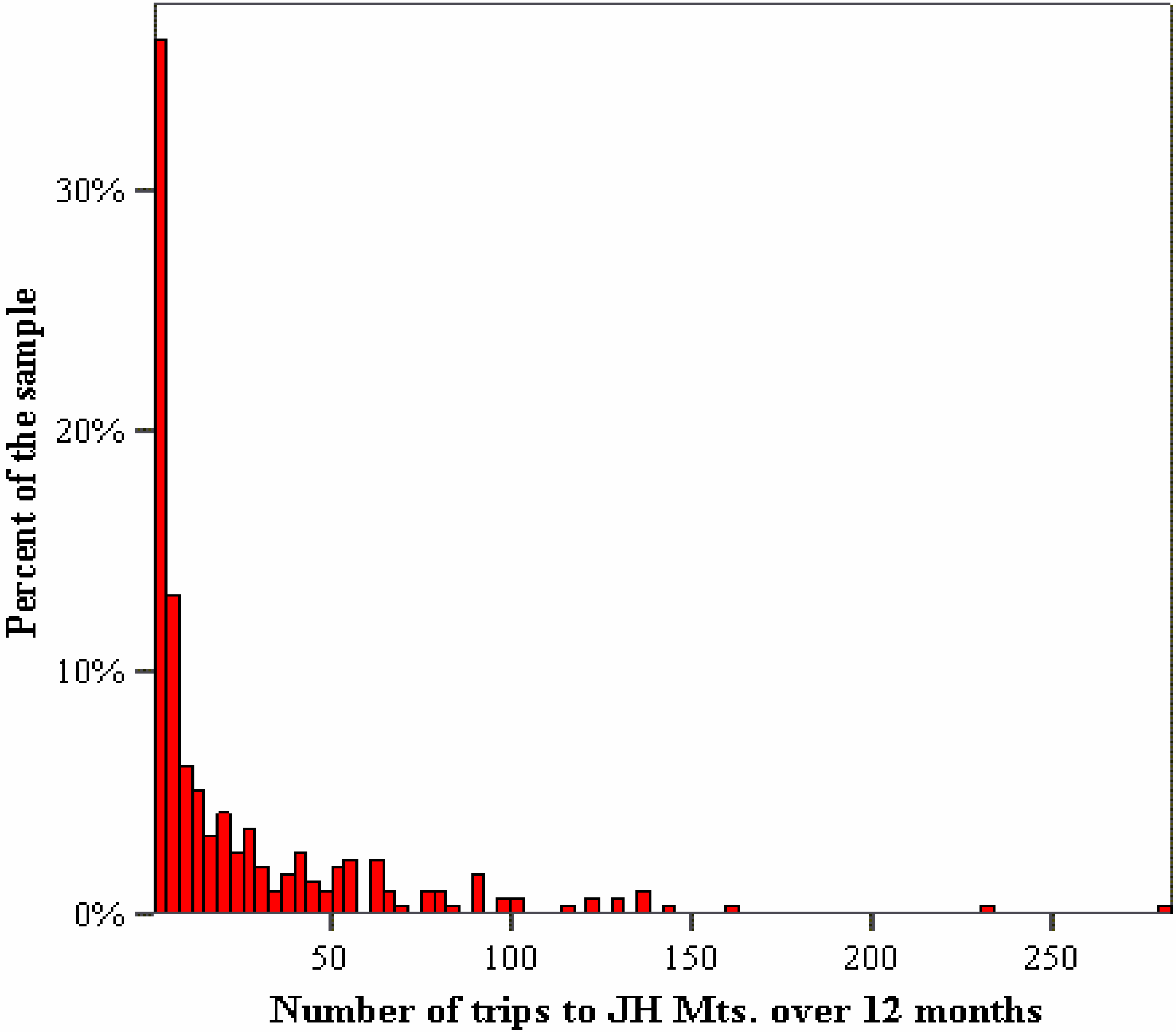
(green)	SPRUCE WOOD	20 %
(yellow)	BROAD-LEAVED TREES	80 %

BROAD-LEAVED TREES

Implement of the survey

- **Pre-test** (June, July)
  - several in-depth interviews ⇒ it is problematic to realize one hour interview with visitors in terrain
- **4 pilot surveys** (July, August)
  - around 30 - 70 respondents in each pilot
- **Final surveys** (September, October)
  - total of 201 completed questionnaires – version 1 with tourist infrastructure assessment
  - total of 312 completed questionnaires – version 2 with hypothetical situations

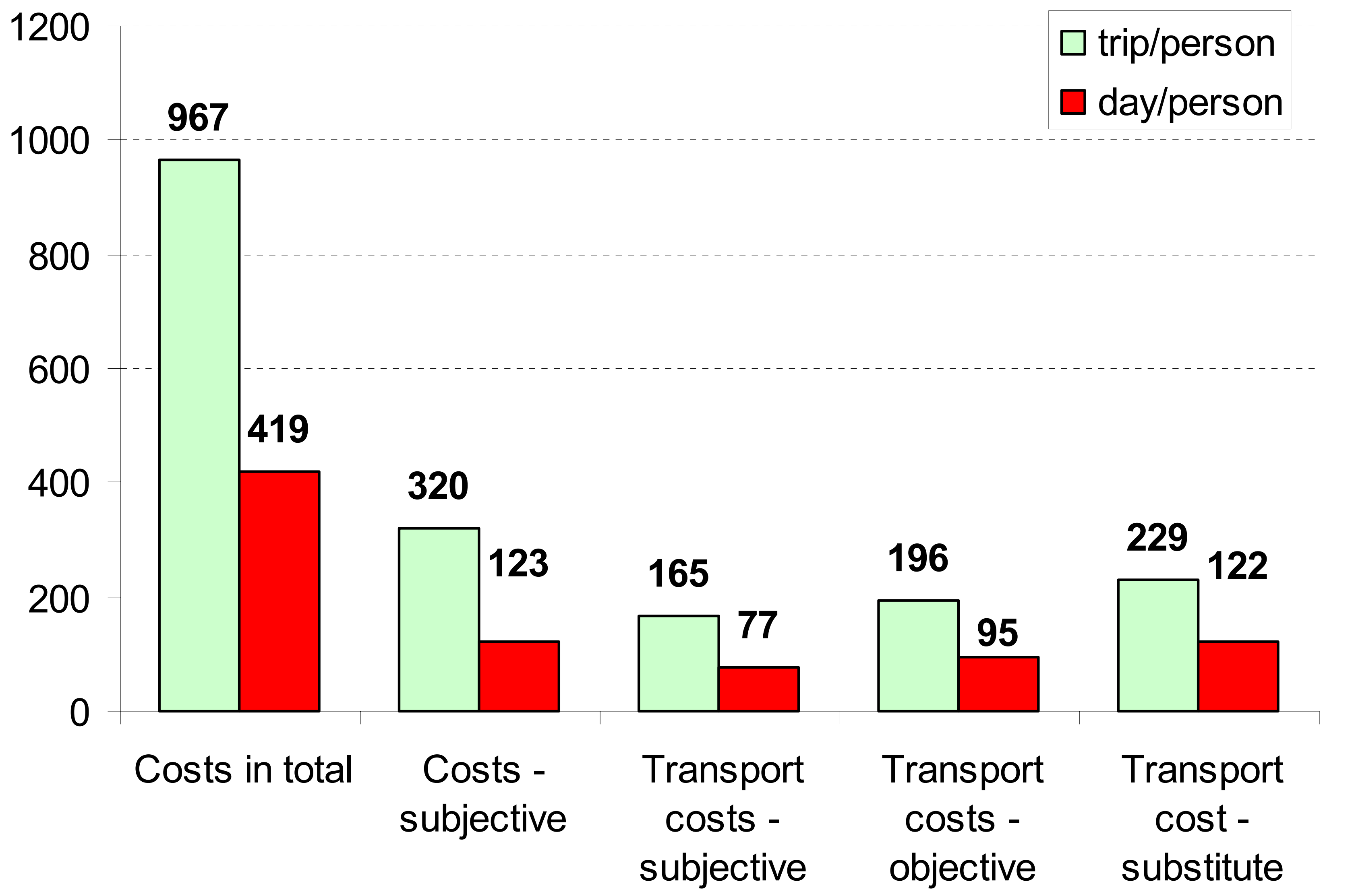
Histogram of the number of trips realized to JH Mts., n = 312



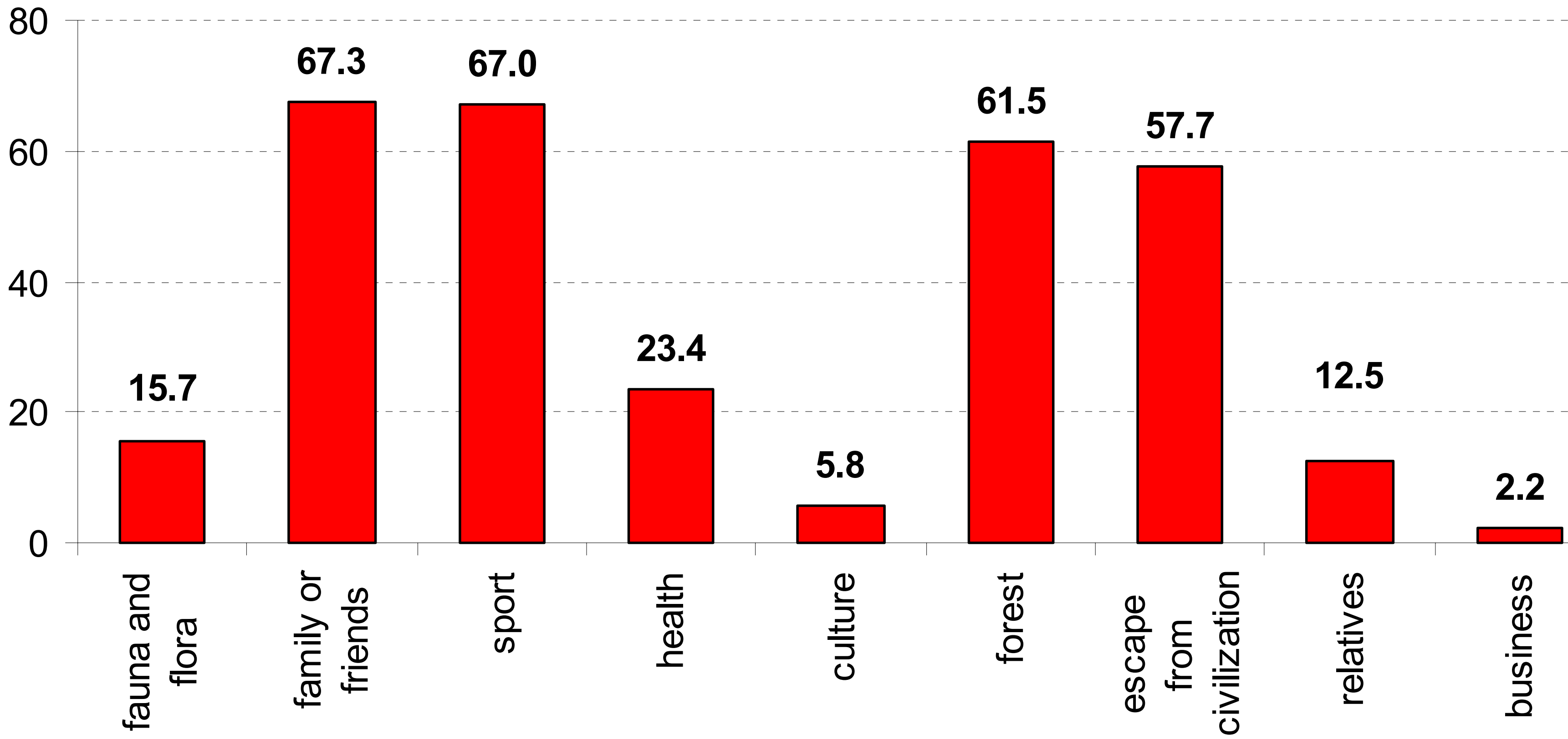
Structure and frequency of visits to JH Mts., n = 312

	Mean	Median	Std. dev.	Minimum	Maximu
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

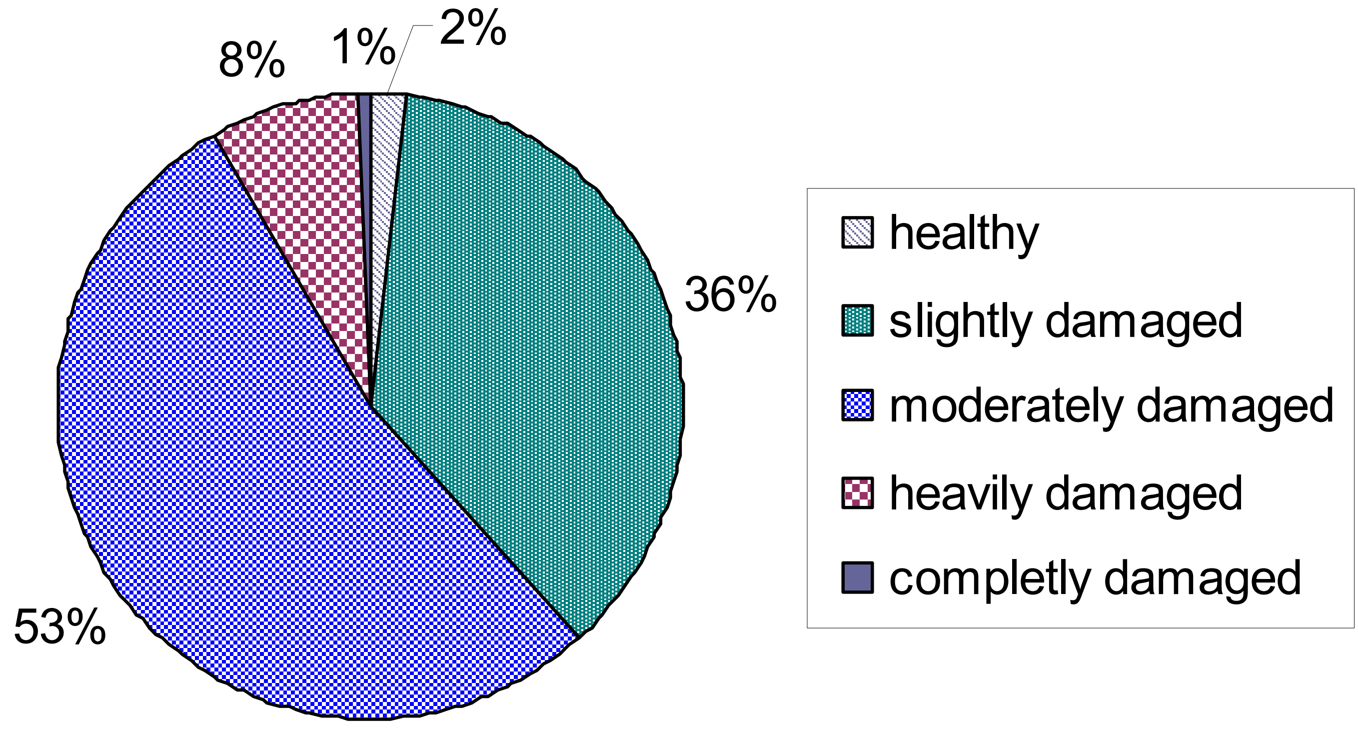
The total costs, subjective and objective costs on a trip to JH Mts. (CZK), n = 312



Motives of respondents for visiting JH Mts., n = 312



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



The structure of answers on hypothetical questions, in %, n = 312

	N (valid)	increase	equal	decrease
Change of 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 of 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

Econometric model

Count data – non-negative integer value

Poisson distribution

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

Negative Binominal distributio

λ … the expected number of trips = $\mathrm{Var}(y_i|x$

$\lambda_{ij} = \exp(x_{ij}\,\beta_1 + p_{ij}\beta_2 + q_j\beta_3)$

Maximum likelihood method

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

Likelihood function

Model 1: ML estimation of the actual visits, Poisson model, n = 312

Variable	coefficient	standard error	confidence interva	
Intercept	2.2535	0.0552	2.1453	2.361
COSTS	-0.0029	0.0001	-0.0031	-0.002
AGE	0.0171	0.0009	0.0153	0.018
ECONOM	0.3265	0.0315	0.2647	0.388
LENGTH	0.0119	0.0006	0.0108	0.01
Log likelihood		17 763		

CS per access	**CZK 8 054 (USD 366)**
min	CZK 7 535
max	CZK 8 342

CS per trip	**CZK 344 (USD 15)**

Model 2: ML estimation of the actual and contingent visits, Poisson model, n = 1 248

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			

CS change per access **CZK 1 574 (USD 71)**

CS change per trip **CZK 67 (USD 3)**

Discussion needed

- Surveying only in September and October 2005
- Opportunity costs of time not included
- $Var(y_i|x_i) > \lambda \Rightarrow$ Negative Binominal distribution
- # of trips and # of days on trip are positively correlated

⬇

Bivariate Poisson needed

- Not all values related to the change of environmental quality are assessed

Thank you for your attention

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