



# Perceptions of natural disturbance in Tatra National Park, Poland

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## Abstract

Since the last decades, natural disturbances in forests including protected areas have intensified. They have the potential to impact visual quality and safety of visitors as well as spread beyond protected area boundaries. While economic and ecological impacts are well studied, there is still a lack of work focused on human dimensions and social aspects. This study examines visitor perceptions towards bark beetle infestation in Tatra National Park, Poland. The findings, based on visitor surveys collected during the summer of 2014, indicate the significance of different factors influencing visitor attitudes towards the bark beetle. Age of visitors and importance of the bark beetle issue for them (based on subjective ratings of importance of bark beetle issue for respondents) are the most prominent variables. Also place of origin and environmental worldview were recognized as significantly important variables in accordance with similar studies. Results suggest management implications for park authorities including public relations and environmental education in order to increase knowledge and support for natural disturbance and ecological integrity policies in the national park.

**Key words:** visitor perception; protected areas; human dimensions; bark beetle; forest

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## 1. Introduction

The shift to an ecosystem management framework during the last decades has also brought a paradigm shift in perception of the role of ecological disturbance in natural resources management, so that they are now seen not as negative events but as more value-neutral from an ecological point of view (being part of healthy and dynamic ecosystems). On the other hand, from a human dimensions standpoint, they are rarely seen as value-neutral events (conflicts on political and societal levels). While ecological and biophysical parameters of forest disturbances by insects are relatively well studied, human dimensions (societal impacts and implications) are still neglected (Flint et al. 2009).

Natural disturbances (abiotic or biotic) are fundamental to the development of structure and function of forest ecosystems (Attiwill 1994). However, forest disturbance regimes may heavily affect forest functions as well as forest management (Seidl et al. 2008). Damage from natural disturbances in European forests seems to be increasing in the future (Schelhaas et al. 2003). Windstorms are among the most severe disturbances that affect mountain forests in central Europe, including the High Tatras Mountains (Zielonka & Malcher 2009; Mezei et al. 2014). Many authors have analyzed the frequency and severity of disturbances and their effects on tree recruitment (Szewczyk et al. 2011) including different management strategies. Forest insect infestations, usually followed by windstorms, are considered one of the most pervasive and important agents of disturbances in forests. All aspects of insect outbreak behavior will intensify as the climate warms (Logan et al. 2003). Some studies

are focused on particular agents; Wermelinger (2004), for example, summarizes the ecology and management of the spruce bark beetle (*Ips typographus* (Linnaeus, 1758)) in forests. Ecological disturbances of forests by insects have a complex array of associated human dimensions presenting complications for natural resource decision-making. As examples we can mention visual-quality impacts at the landscape level (Sheppard & Picard 2006), increased fire hazard and potential fire behavior (Jenkins et al. 2008) or relationships between stakeholders and managers (Flint et al. 2009).

Visitors represent an important stakeholder in the management of natural disturbances in protected areas (Müller & Job 2009). A primary objective of category II protected areas (national parks) is to protect natural biodiversity and to promote education and recreation. Extractive use is not considered consistent with this objective (Dudley 2008). This means that they are mandated to protect ecosystems from human interference and make them accessible for recreational activities (Müller et al. 2008). Areas designated as core zones prohibit any management intervention in natural forest dynamics. The goal of the present study is to identify what visitor attitudes towards bark beetle infestation and management are. Park administration can use the obtained results as contribution for development of management strategies which might be applied in Tatra National Park.

## 2. Study area and methodology

Tatra National Park, founded in 1955, is located in the southern part of Poland along the Slovakia border (Fig. 1).

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The area is also designated as a UNESCO biosphere reserve and, along with the Slovak side, an EU Natura 2000 site. The national park comprises an area of 21 197 hectares of which 82% is publicly owned land. Forest ecosystems account for 72% of the area of which about 58% is natural or semi-natural forests. The core zone of the park makes up about 60% of the total land area, the other parts include a buffer and a transition zone. While 92% of the forest area now consists of spruce (*Picea abies* L.), silver fir (*Abies alba* Mill.) and European beech (*Fagus sylvatica* L.) are expected to increase to 20% and 13%, respectively, resulting in a decrease in spruce areas, according to forest management plans (this will be a result of forestry; natural processes would take a much longer time to change tree composition). The national park is an important tourist attraction for the region; current annual ticket purchases by accessing the park number about 3 million. The national park administration implements and monitors visitor management policy – e.g. restriction of access to certain areas (Getzner 2010).

An intensive bark beetle (mainly *Ips typographus*, rarely also *Ips cembrae* (Heer, 1836)) outbreak occurred between 1993 and 1998 and again between 2009 and 2013 in the Tatra Mountains of Slovakia and Poland. In Poland, the outbreak was primarily located in reserve areas where pest management or other activities were prohibited. The size of affected areas with dead stands increased from 180 ha in 2009 to 590 ha in 2012. Glades (clearings covered by deadwood or without trees) increased in same time from 50 ha to 70 ha and new growth (regrowth or young generation) from 10 to 30 ha. The biggest augmentation in above mentioned categories of affected areas in forest were registered in 2013 in Gąsienicowa Valley.



Fig. 1. Location of the park in central Europe and position of study area in the network of national parks in Poland © Tatra National Park, Poland.

To understand visitor perceptions, face to face on-site interviews were carried out by park volunteers during two weeks in the summer of 2014 (25.08.–07.09.2014). Respondents were enquired on Morskie Oko road which is the highest visited area in the park with 12 500 visitors per day during vacation. The research design chosen replicated a similar survey conducted in Germany (Bavarian Forest National Park). Independent variables were hypothesized as predictors for tourist attitude towards the bark beetle (see Müller & Job 2009) and 511 valid questionnaires were collected (79 refused). With recent visitation obtained sample size was sufficient to reach a confidence level with interval of 95±5%<sup>1</sup>. Data were collected in software IBM SPSS 19 and analyzed with multivariate linear regression model.

### 3. Results

Demographic characteristics of visitors are ranked by frequency of cases – 51.8% of respondents were male, the average age was 34.48 years and 49% of the individuals sampled had a university degree. Respondents visited the study area an average 5.67 times, and they were predominantly from Poland (98.8%) and most (47.8%) live in a major city – see Table 1.

Table 1. Demographics of respondents and characteristics of visit used in survey.

Gender	
Female	48.2%
Male	51.8%
Age (mean)	34.48 years
Highest level of education	
Primary / Elementary school	1.6%
Secondary school	46.1%
University degree	49.0%
Other	3.3%
Number of visits in TPN (mean)	5.67
Country of visitors	
Poland	98.8%
Others (A, D, GB, SK)	1.2%
Origin of visitors	
Major city	47.8%
Provincial town	30.5%
Countryside	21.7%

Participants stayed an average of 3.23 nights in the region of the national park. Visitors could choose multiple options and named taking walks and hiking (79%), relaxation and spending time with family (25%), and enjoying nature (20%) as their primary motivations for their field trips to Tatra National Park. 62.7% of respondents stated that their expectations were fulfilled completely. A majority of respondents (87%) were impressed the most by landscape and nature, only a negligible percentage (9%) demonstrated an awareness of forest dieback and dead standing trees. 91.6% of visitors expressed their intention to spend their holidays in the park again.

<sup>1</sup><http://www.surveysystem.com/sscalc.htm>

We also tested the environmental worldview of visitors based on New Ecological Paradigm statements which describe the relationship between man and nature (as one of the predictors of later visitor attitudes towards bark beetle – see Müller & Job 2009). Respondents were asked to agree or disagree on a 5-point scale (5 = “fully agree” to 1 = “completely reject”). Generally we can see quite pro-ecological / positive attitudes – especially with the statement that ecological balance is very delicate and can be easily disrupted (4.40 points) – see Table 2. For most visitors, the existence of a national park influenced their decision to visit this region (very much – 28.3% and much – 24.9%).

**Table 2.** Descriptive statistics of statements describing relationship between man and nature based on New Ecological Paradigm statements (for comparison see Müller & Job 2009). “Respondents were asked to agree or disagree on a 5-point scale (5 = “fully agree” to 1 = “completely reject”)”.

Evaluative items	Min.	Max.	Mean	Std. Deviation
earth has enough natural resources, use them wisely	1	5	4.20	0.880
environment for satisfying demands of mankind	1	5	3.02	1.063
ecological balance is delicate and can be disrupted	1	5	4.40	0.741
human talent will make earth to be inhabitable	1	5	3.41	1.056
mankind overuses currently natural resources	1	5	4.09	0.960

The next part of the survey focused on natural disturbance in the forests. Nearly one third of respondents (30.3%) recognized dead trees during their walks and hikes in the national park. Further, 85.7% of visitors know that there are dead trees on a large scale in the national park area. As a source of information about dead trees, visitors responded that they saw them in the area for themselves (73%) and only a small part chose another option (e.g. TV – 9%). Respondents stated the reason for the large scale forest decline as bark beetle (26.2%), air or environmental pollution (20.2%), or natural reasons (18%). However, only a very limited number of respondents in the next question assessed their personal knowledge about bark beetles and their impact on the national park as good (5.2%) or very good (1.6%). When visitors were asked how important the bark beetle issue is in a national park for them personally according to a scale from

5 (very important) to 1 (completely insignificant), 41% of them selected option 4 (important).

In the final part of the survey, visitors were asked again to agree or disagree along a 5-point scale (1 = “strongly disagree” to 5 = “strongly agree”) on their statements about the bark beetle in a national park. The first four statements (Table 3) described positive roles of the bark beetle for the forest. Generally we can see medium (neutral) preferences in the case of the statement that bark beetle should have a right to exist in a national park, positive preference was stated (3.64 points). The other four statements (Table 3) describing negative roles of the bark beetle for the forest were inverted (1 = “strongly agree” to 5 = “strongly disagree”). Again, we can see medium preferences but they mostly confirmed the statement that the bark beetle is a threat to biodiversity (2.50 points). 74.3% of respondents trust that areas of dead standing trees will develop in the future as young-growth forest after regeneration and natural rejuvenation.

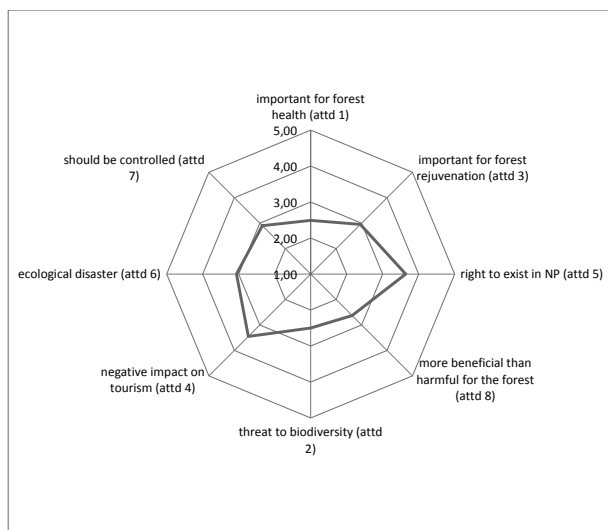
**Table 3.** Descriptive statistics of statements describing positive (attd 1, 3, 5, 8) and negative (attd 2, 4, 6, 7) roles of bark beetle for forest along a 5-point scale (1=“strongly disagree” to 5=“strongly agree” resp. inverted for negative roles) (for comparison see Müller & Job 2009).

The bark beetle...	Min.	Max.	Mean	SD
...helps ensure that forests are healthy (attd 1)	1	5	2.49	1.045
...is important in rejuvenating the forest (attd 3)	1	5	2.95	1.082
...should have a right to exist in the park (attd 5)	1	5	3.64	1.004
...is more beneficial than harmful for the forest in the park (attd 8)	1	5	2.63	0.958
...is a threat to biodiversity in the park (attd 2)	1	5	2.50	0.997
...has a negative impact on tourism (attd 4)	1	5	3.45	1.177
...is an ecological disaster for the park (attd 6)	1	5	3.06	1.054
...should be controlled in the park (attd 7)	1	5	2.90	1.069

The arithmetic mean of eight attitudinal items was calculated using a Likert scale (Fig. 2) to evaluate the attitudes towards the bark beetle. For further analyses we used only 322 cases, those without any missing information, to analyze which predictors significantly influence visitor attitudes towards the bark beetle as dependent variable. Results demonstrate that younger respondents had better attitudes towards the bark beetle (Table 4). The importance of the bark beetle issue (based on subjective rating for respondent), place of origin (urban vs. urban rural areas) and environmental worldview are also significantly important.

**Table 4.** Multivariate linear regression model of mean bark beetle statements as a function of significant predictors (Adjusted R square = 0.189, n = 322).

Predictors	Mean of bark beetle statements		Unstandardized Coefficients		Standardized Coefficients	t	P
	B	Std. Error	B	Std. Error	Beta		
(Constant)	3.631	0.363				10.002	0.000
Age (years)	-0.014	0.003			-0.249	-4.835	0.000
Importance of bark beetle issue	-0.192	0.042			-0.238	-4.577	0.000
Major city	0.190	0.072			0.135	2.651	0.008
Statements describing man and nature (earth and natural resources)	0.093	0.040			0.116	2.302	0.022
Activity...quietude, relaxation, winding down, spending time with family	-0.193	0.082			-0.120	-2.345	0.020
Filling of expectations	0.099	0.046			0.110	2.162	0.031
Statements describing man and nature (overuses of natural resources)	-0.077	0.037			-0.105	-2.064	0.040



**Fig. 2.** The arithmetic mean of 4 positive and 4 negative attitudinal statements describing visitor attitudes towards the bark beetle in Tatra National Park on 5-point Likert scale (higher number means better attitude – see also Table 3).

#### 4. Discussion

Existing literature (e.g. Flint et al. 2009) is underlying and focuses on agents, host trees, overall setting, and size of affected area. It is also important to understand different aspects or sectors of human dimensions of forest disturbances by insects. Economic impacts can especially be connected with commercial forestry: short-term increased forestry vs. long-term decreased timber supply. In regions oriented on tourism and recreation, effects on visitation can also be a concern (aesthetic and safety issues – e.g. falling trees). Social impact is connected mainly with aesthetic impacts (e.g. perception of dead wood – lying dead trees covered by visible green-up vs. standing dead trees), emotional response, high risk perceptions of fire, and temporal dynamic to public reaction. Management responses vary from salvage logging on commercial forest lands, preventative and fuel treatments in urban areas to no intervention in protected areas. The reaction of different stakeholders can also be very different – private landowners, local residents, tourists, and communities. The above mentioned examples of impacts and implications only underline the requirement of different strategies and good knowledge of local settings and conditions (including historical, regional and political context).

Comparing our findings with the results from the Bavarian Forest National Park (Müller et al. 2008), in general visitors in Germany exhibited a better attitude towards the bark beetle; several predictors (e.g. affinity of visitors towards the national park) were significant. On the other hand, our study confirmed the importance of age and urban residence towards attitude. Experiences from Canada (McFarlane et al. 2006) showed that proactive approaches in uninfested forests were generally not supported. Attitudes were the best predictors of support for no intervention in beetle infesta-

tions in Canada’s national parks. McFarlane & Witson (2008) discovered that knowledge and residency were the most consistent predictors of risk judgments. Survey data were collected by both mail and onsite with park visitors. Visitors rated the ecological and visitor experience impacts as negative and unacceptable. Participants of the survey in Canada largely supported controlling future outbreaks with biological control (Chang et al. 2009). They generally agreed that ecologically sensitive areas and wildlife habitat were the top priorities that should be protected. Socio-demographic factors found to positively influence preferred control extent included level of knowledge, age, education, income, and work in the forest industry. Findings from Colorado (USA) suggest that respondents from lower amenity communities with more recent emphasis on resource extraction and higher tree mortality had significantly higher risk perceptions of mountain pine beetle impacts (Flint et al. 2012). Some studies from North America (Sheppard & Picard 2006) showed that informed respondents consider visual quality of affected scenes to be lower than do uninformed respondents, but this may reflect the way in which the information was delivered. Public stakeholder attitudes to pest and disease management can influence the decisions of forest managers and NGOs involved in responding (Fuller et al. 2016). Acceptance of management can also differ according to location and local context (e.g. management is less supported when it may impact wildlife).

Similar studies and methods used for investigation are often connected with the potential problems of the self-selection bias and of the representativeness of on-site survey. Social science research is used to support the formulation of natural resource management decisions with accurate and timely information (Czaja & Cottrell 2014). Managing protected areas requires information about the proportion of visitors attracted by the national park label and visitor attitudes towards protected area management (Arnberger et al. 2012). Changes in bio-physical and social systems due to large-scale forest disturbances have the potential to dramatically alter public participation in decision making processes (Smith 2013).

#### 5. Conclusion

Results of this study can be used for further discussions of different economic and non-economic implications, strategies, community responses and capacities, and comparisons with similar case studies. Resource managers and decision makers should be able to respond to questions on the role of disturbances in ecosystems, how well they are accepted by visitors, what is the role of protected area settings, and how to manage natural disturbances in protected areas. We confirmed that some factors driving visitor attitudes could be influenced directly by the park management. For future research it would be advisable to test more predictors (e.g. income of visitors), develop different models to increase validity and test it for different stakeholder groups.

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