Usefulness of GPS tracking in monitoring skitourers' activity in Tatra National Park, Poland

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Introduction

The nature of ski touring is to penetrate wild spaces and to move freely in open terrain covered with snow, which could lead to conflicts in the areas where many species of wild fauna can be met. These conflicts between recreational use of protected areas and nature conservation have been reported worldwide as well as in Tatra National Park (TNP) in Poland [Bielański 2013]. TNP offers a unique opportunity for skitourers being the only Alpine-like mountains within the whole country (culminating at 2499 meters above the sea level). Its size (21 164 ha) and very high visitation number (approx. 3,000,000 per year) are often a cause for exceeding its carrying capacity [Skawiński 2010]. Ski touring traffic is concentrating during the spring due to a longer day, sunny weather, low avalanche risk and sufficient snow cover. The peak months are March and April. Total number of skitourers' visits to TNP have recently reached 10 000 (December through May) [Bielański 2013]. Ski touring popularity has been growing in Tatras rapidly, which is a great concern for the park management since it tends to spread above the timber line in an uncontrolled manner. On the other hand, TNP regulations strictly define rules and trials designated for skitourers [Bielański, Cybula, Ziobrowski 2013]. Some incidents of illegal trespassing have been reported by the Park staff (TNP unpublished data, 2013) but no statistics on spatial nor temporal distribution has been provided.

In this study the authors attempted to use the GPS devices in order to recognize the spatial and temporal distribution of skitourers in TNP. The applied method based on experiences from other areas described by several authors [e.g. Taczanowska et al. 2008]. This led to creation of digital density maps, which allowed to define park areas with high concentration of skitourers as well as to estimate potential threats to natural environment such as crossing of wild fauna territories. Furthermore, due to the Park internal regulations it was important to identify the percentage of ski touring traffic outside the designated trials (illegal dispersion).

Methods

In order to create a digital map of skitourers' activity within TNP, GPS Loggers were distributed at four Park's entry points throughout the winter season of 2011. When the snow cover was melting down during the late spring, distribution points were moved to mountain huts located higher above the sea level (fig.1).

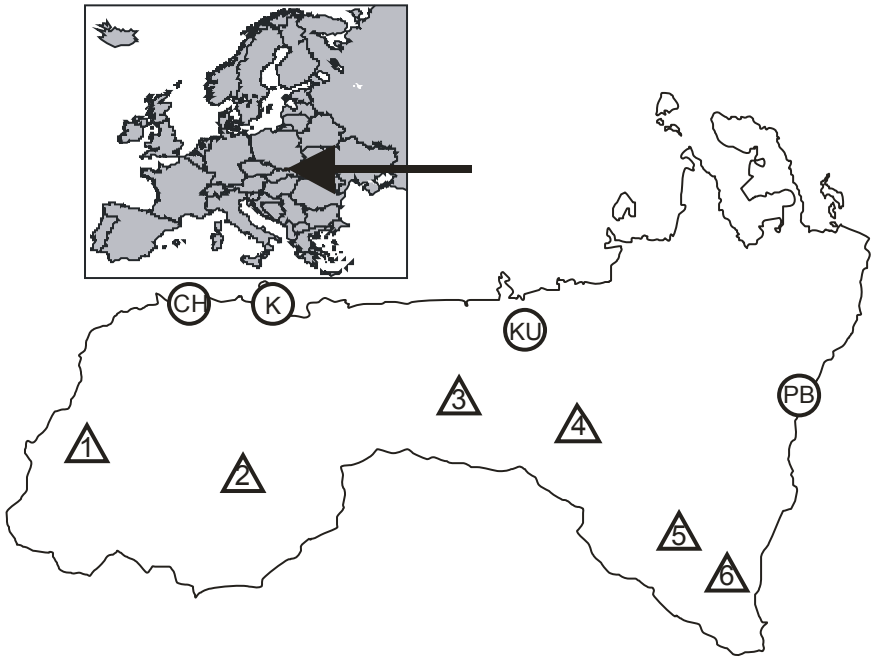

Fig. 1 Location of GPS Loggers distribution points in Tatra National Park
GPS loggers distribution points:
entries / extits points: CH : Chochołowska Valley, K–Kościeliska Valley, KU – Kuźnice, PB – Palenica Białczańska
mountain huts: 1 –Chochołowska, 2 –Hala Ornak, 3 –Kondratowa, 4 –Murowaniec, 5 –Pięć Stawów Polskich Valley, 6 –Morskie Oko

GPS logger device used in the survey was Hollux M-1000C. The position of the skitourers was registered every 120 sec. and/or every 50 meters. GPS loggers were collected into boxes attached at the entry/exit points in the Park that allowed for 24 hour return time. A total number of 343 tracks were successfully downloaded to a PC, and only 31 GPS tracks failed to be red. Subsequently, it was necessary to clear some artefacts, which occurred as a result of GPS signal reflection, which took place at the moment of starting up in deep mountain valleys. These kinds of artefacts were also observed when a skitourer stood still for a longer time.
Subsequently, the tracks were aggregated in ArcGIS 9.3 software and further spatial analyses were performed using digital maps of Polish Tatras (1:10000).

Results

Skitourers' digital traces allowed creating their traffic density map, which was a base to reveal the most popular spots in the TNP. Moreover the data collected with the GPS devices showed that the illegal dispersion rate reached 20%. In further analysis the authors also studied environmental impacts of skitourers. It was found that 19,25 % of the skitourers' traffic had crossed territories occupied by chamois and 24,15% of them interfered with marmots sites. In the high avalanche risk areas only 5% of the group were observed.

Discussion

One of the authors' fundamental concerns during this study was the issue of negative attitude of the researched group towards TNP authorities. This could have influenced the results if some skitourers had refused to take the GPS units planning to go off the designated trials. Such conflicts had been earlier observed in Tatras [Krupa 2006] and in the other national parks in southern Poland. Fortunately, in the study presented here the refuse rate occurred to be relatively low (13%). Moreover, the authors verified the results of GPS analysis by conducting a direct observation.

Comparing results with illegal dispersion rate form neither of the sources revealed any statistically significant difference ($p>0,1$).

Interpretation of the GPS data analysis was also a matter of discussion. It is a case of the researcher's choice which method is more adequate for the subject of the survey. One method is to analyse a number of GPS points (e.g. beyond the marked trial area). Another is to analyse a number of the GPS tracks as whole lines. The second approach, taking into consideration the number of the whole tracks (as lines) would only give the information on how many of the observed persons were present in the analysed area but with no indication of its duration. This would lead to a conclusion that the person who was present in the analysed territory for only 5 minutes would be equal to the person who stayed there for few hours. The authors have decided to apply the first method (points), as the one showing the duration presence of skitourers, which seemed to be more adequate when considering the human impact on wild fauna (or illegal dispersion).

Conclusions

The use of GPS units in monitoring ski touring activity in Polish Tatras proved to be very accurate. Although it has some limitations and requires adequate interpretation it seems to be a helpful tool for the Park managers especially when considering visitors who tend to spread over the open spaces. The GPS tracks analysis also allowed identifying some spatial characteristics of skitourers' movements in Tatras that would be difficult or impossible to observe using the traditional methods.

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