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Effectiveness of an acoustic wildlife warning device using natural calls to reduce the risk of train collisions with animals

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ABSTRACT

The subject of study was the effectiveness of the UOZ-1 device – which emits the natural warning calls of animals – in protecting animals living near railway tracks. We performed the investigations in central Poland between 2008 and 2012 at two study sites along the E 20 line where the UOZ-1 devices had been installed. We used digital cameras to register animal activity 24 h a day, resulting in 2262 mammal observations (involving 2956 individuals). In 76% of the observations, no rail transport was observed. When a train did approach and acoustic signals were emitted, most of the wild mammals escaped (93–85% of cases, depending on the species). Regarding the most numerous species, the roe deer, the effectiveness of the device was tested by comparing the animals' reactions when a train approached with the device switched on or off. With sound signals emitted, animals escaped more often (84% vs. 68%), and their reaction to an oncoming train was 20 s faster. We found no proof that animals habituated to the warning signals because the proportion of roe deer that showed no reaction was similar in the first and last year of the study. There was also no difference between the reaction time to an oncoming train (on average 35 s). The results of this research indicate that the UOZ-1 is more effective in reducing the risk of train–animal collision, by prompting animals to leave the railway track faster and with greater frequency, than only the sound of an oncoming train.

Introduction

As Poland's railway lines are modernised, it is required to assure safety of passengers but also to maintain the effect of rail transport on the environment as reduced as possible. Numerous studies addressed the negative influence of technical infrastructure on the populations of different groups of vertebrates and on their environments in relation to new road developments (review in Spellerberg, 2002; review in Forman et al., 2003; Steiner et al., 2014). Research on possible collisions between trains and wildlife focussed mainly on medium or large mammals (Wasilewski et al., 2009; Kušta et al., 2011; Jasińska et al., 2014, review in: Steiner et al., 2014), including the Sika deer *Cervus nippon* (Ando, 2003) and the moose *Alces alces* (Modafferi, 1991; Jaren et al., 1991; Andersen et al., 1991; Child et al., 1991; Gundersen et al., 1998).

Several technical devices aiming to deter animals from roads, railway lines, airports or cultivated fields have been invented. Most of these devices make sounds, including, for example, ultrasonic whistles that emit soundwaves at frequencies above 20 kHz. However, tests of these devices on animals such as the white-tailed deer (*Odocoileus virginianus*) (Curtis et al., 1995; Belant et al., 1998), black-tailed deer (*Odocoileus hemionus*) (Romin and Dalton, 1992; Putman, 1997), dingo

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(*Canis lupus dingo*) (Edgar et al., 2007) and birds (Woronecki, 1988) have indicated that they are ineffective. There are other devices that produce noise, such as various types of rattles, klaxons and sirens, whistles, recordings of human voices, and explosions or fired shots (Woronecki, 1988; Koehler et al., 1990; Ujvári et al., 2004). They might be effective, but have only produced the desired effect over very short periods (Woronecki, 1988; Koehler et al., 1990; Ujvári et al., 2004). Indeed, irrespective of type, frequency or intensity of the emitted sound, experiments have usually showed a steady process of habituation (Bomford and O'Brien, 1990). Under these circumstances, devices that use natural calls and other sounds made by animals might be the most promising. However, little research on this topic has been conducted (Koehler et al., 1990; Gilsdorf et al., 2002).

A device that fills this gap is the UOZ-1 (in which UOZ stands for *urządzenie ochrony zwierząt*, meaning "animal protection device"). It is produced in Poland by NEEL Ltd. (www.neel.com.pl access on 10.10.14). The assumption is that natural warning calls used in UOZ-1 can modify the behaviour of wild animals by hastening their escape from rail track in advance of an oncoming train. Emitted sound signals are supposed to produce natural reactions in animals because they are translated as a warning of growing danger and a direct threat to life. The sound sequence in the UOZ-1 combines several natural alarm calls known to animals. These are: the warning call of the jay *Garrulus glandarius*, the sound made by a frightened brown hare *Lepus europaeus*, the growling and barking of the dog *Canis familiaris*, the howl of the wolf *Canis lupus*, the squeal of the wild boar *Sus scrofa*, and the warning voice of roe deer *Capreolus capreolus*. In natural conditions, these animal sounds would usually be associated with a growing threat to animals, aggression within a species, predatory behaviour, or even death (Kossak, 2007).

The UOZ-1 device is cylinder-shaped, 110 cm high and 30 cm wide in diameter (Fig. 1). It is prepared to work in a range of temperatures from −40 to +55 °C. They are installed in groups every 70 m, each one on the alternate side of the railway tracks and permanently mounted on concrete foundations. This distance is assumed to be a minimal effective operational range of a single UOZ-1 device; hence, it ensures a continuous protected area. The complete animal protection system consists of UOZ-1 devices installed adjacent to the rail tracks and interoperating with UOZ-MDS control modules, installed in containers of the automatic block signal system or in specialised KUOZ containers. The sound emission is activated by signals received from an automatic railway system; just before (usually 60 s, time is set in the range of 30 s to 3 min) the arrival of a train at a given location, the device switches on and emits a sequence of sounds, switching off again as a train passes. Power is provided to the device via cables from the KUOZ container or automatic block signal system container, with a 230 V 50 Hz separated voltage. The maximum amount of power drawn by a single UOZ-1 device is approximately 40 VA, which is the highest setting of signals emitted. The actual average amount of power drawn while in standby mode is approximately 25 VA (www.neel.com.pl, access on 10.10.14). An average installation cost of one device (in Poland) is from 30,000 to 50,000 PLN (approximately 8000–14,000 USD), including projects, equipment and installation. The more devices are installed in one place the lower unit cost. The maintenance cost includes service check twice a year, two technicians can service up to 30 devices in one day (Stolarski M., pers. inf.).

The aim of this study was to determine the reactions of mammals to sound signals emitted by the UOZ-1 device before the passing of a train, and thus characterise its effectiveness by comparing the frequency and speed of different reaction to an approaching train with the UOZ-1 devices switched on and off. Our study also focused on animal reactions in successive years to determine whether animals would begin to react differently to the emitted signals over time, suggesting that they have become accustomed to the acoustic stimuli.

Study area

We performed the research in central Poland along a modernised part of the E 20 line between Mińsk Mazowiecki and Siedlce (ca. 50 km). The track here runs through a field-forest mosaic. Approximately half of the distance (24.4 km) was surrounded by a mosaic of the following habitat types: small and fragmentary patches of woodland (42%), open areas (mostly

Fig. 1. Installation of UOZ-1 protective devices along the railway line.