Landscape and Urban Planning 134 (2015) 76–82

Contents lists available at ScienceDirect

Landscape and Urban Planning

journal homepage: www.elsevier.com/locate/landurbplan

Research paper

The influence of road traffic on birds during autumn period: Implications for planning and management of road network

Jarosław Wiącek[a,*], Marcin Polak[a], Marek Kucharczyk[a], Janusz Bohatkiewicz[b]

[a] Department of Nature Conservation, Institute of Biology and Biochemistry, Maria Curie-Skłodowska University, Akademicka 19, 20-033 Lublin, Poland
[b] Department of Road and Bridge, Faculty of Civil Engineering and Architecture, Lublin University of Technology, Nadbystrzycka 40, 20-618 Lublin, Poland

HIGHLIGHTS

- Road traffic influences woodland birds during their autumn period.
- Reduced abundance and diversity of birds near a noisy road.
- Noise levels below 49 dB did not significantly affect birds.
- Insectivores preferred the proximity of the road.

ARTICLE INFO

Article history:
Received 13 January 2014
Received in revised form 15 October 2014
Accepted 17 October 2014
Available online 1 November 2014

Keywords:
Autumn period
Biodiversity
Forest management
Traffic noise

ABSTRACT

The main objective of this study was to assess disturbance to birds at stopover sites in the vicinity of roads. We attempted to determine the influence of a busy road on birds during the autumn migration period. To our knowledge this is the first study in Europe carried out during this part of a bird's annual cycle in the context of road noise impact. Individuals were counted using the point method at 36 observation points located at three distances (60 m, 310 m, 560 m) from the road. At each point we determined the habitat parameters and the intensity of noise. In total, 648 individuals from 25 species were recorded on the study plot. The number of birds per point was higher on the second line of points but lower on the last line from the road. Species diversity was lower near the road. The density of the following common species increased with distance from the road: Eurasian jay, great spotted woodpecker, siskin, mistle thrush and nuthatch. Only great tits preferred the proximity of the road. The number and species diversity of birds were correlated with road noise propagation across our study area. Noise levels below 49 dB did not significantly influence the number of birds or species richness. Our results showed that species foraging on invertebrates preferred the neighbourhood of the road. These data may be helpful in planning and managing road environments in the context of bird conservation and protection against road noise.

1. Introduction

In the annual life cycle of birds, migration takes up nearly one third of the year (Sillett & Holmes, 2002). During this period birds spend more time at stopover sites than actually flying (Wikelski et al., 2003). Indeed, foraging and resting may occupy birds for as much as 95% of the migration time (Hedenstrom & Alerstam, 1997; Alerstam, 2003). Some small passerines in particular are not capable of continuous flight during migration, so they stop frequently during their journey to restock the food resources necessary to fuel further flight (Berthold, 2001). During stopovers, birds have to quickly replenish their fat reserves (Moore, Gauthreaux, Kerlinger, & Simons, 1995). To do so, birds feed voraciously and compete for food; at the same time, however, they are exposed to attack from predators, infections and parasites (Hutto, 1985). Human activities are a significant factor affecting the migration of birds and the duration of their stays at stopover sites. Birds usually avoid sites subject to human interference, because this may have an adverse effect on their foraging (Burger & Gochfeld, 1998), territory use (Andersen, Rongstaf, & Mytton, 1990), survival (West et al., 2002) and numbers (Fernández-Juricic, 2002). The march of civilisation is unceasing, and urbanisation is encroaching on to many areas utilised by animals, including birds (Wight, 2002; Christ, Hillel, Matus, & Sweeting, 2003). The losses and degradation of habitats used by migrating birds are also contributing to the fall in numbers of many species (Sauer et al., 2011). The construction of

* Corresponding author. Tel.: +48 081 537 59 71; fax: +48 081 537 59 01.
E-mail address: wiacek@hektor.umcs.lublin.pl (J. Wiącek).

http://dx.doi.org/10.1016/j.landurbplan.2014.10.016
0169-2046/

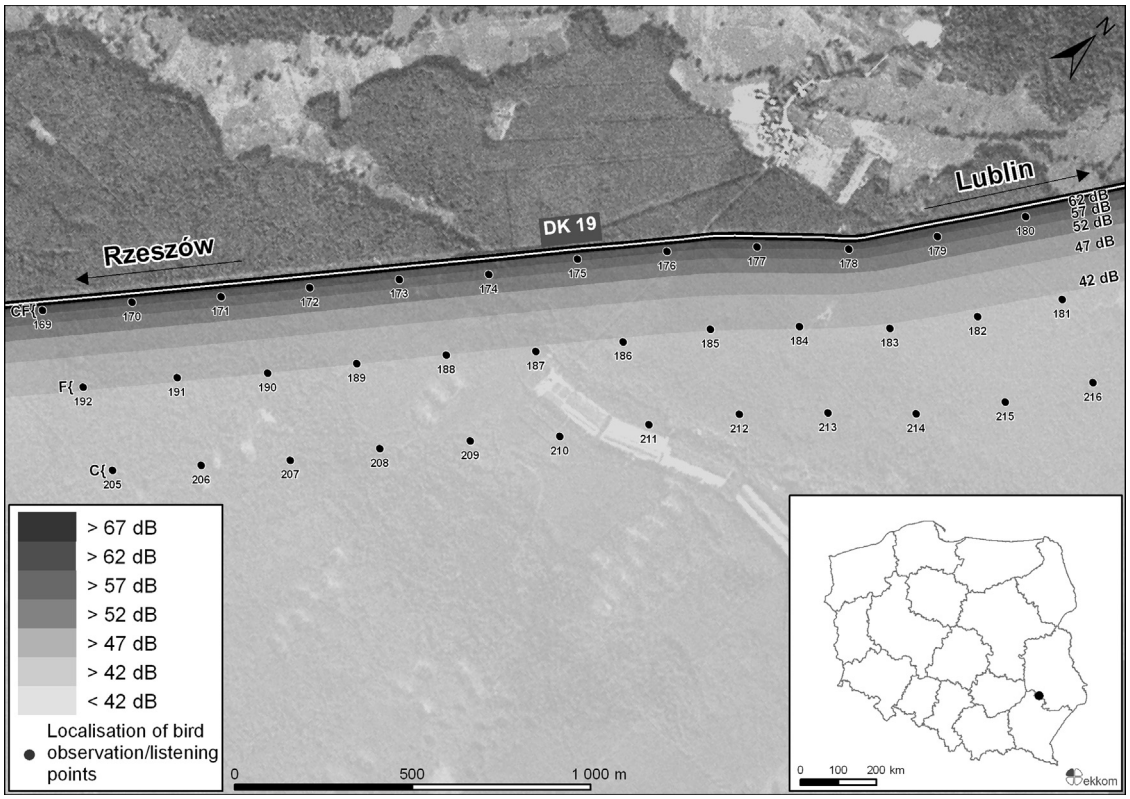

Fig. 1. The study plot with the point-count locations (36 black dots) and noise level isolines during the autumn period near a road in Janów Forest (eastern Poland).

new roads has caused environmental degradation through habitat fragmentation and noise pollution (Šálek, Svobodová, & Zasadil, 2010). The negative impact of road traffic on animals has been reported in the literature (Fahrig, Pedla, Pope, Taylor, & Wegner, 1995; Forman & Sperling, 2003; Fahrig & Rytwinski, 2009) and most papers describe the adverse influence of traffic noise on birds (e.g. Reijnen, Foppen, & Veenbaas, 1997; Kuitunen, Viljanen, Rossi, & Stenroos, 2003; Pescador & Peris, 2007), many of them highlighting the rapid decrease in the density and diversity of birds near roads carrying heavy traffic (Palomino & Carrascal, 2007; Polak, Wiącek, Kucharczyk, & Orzechowski, 2013). Disturbance due to vehicle lights, traffic noise, pollutants in food and the movements of people have been pinpointed by many authors (Pocock & Lawrence, 2005; Wood & Yezerinac, 2006; Slabbekoorn & Ripmeester, 2007; Summers, Cunnington, & Fahrig, 2011). Mortality as a result of collisions with vehicles is the most important negative effect of roads (Orłowski, 2005, 2008). Even so, some species of birds have adapted to an existence near busy roads (Adams & Geis, 1981; Benitez-López, Alkemade, & Verweij, 2010). Although some birds are able to modify their behaviour in a noisy environment (Brumm & Slabbekoorn, 2005), a high level of noise may impair the transmission of sound signals (Kuitunen et al., 2003; Leonard & Horn, 2008; Salaberria & Gil, 2010; Halfwerk, Holleman, Lessells, & Slabbekoorn, 2011).

However, while most papers describing the negative effects of road infrastructure on birds focus on the breeding season, we still know too little about how traffic noise affects avian ecology in the non-breeding period. The "phantom road" experiment, recently carried out during the autumn migration in Idaho, USA, has provided compelling evidence that traffic noise is the main factor impacting adversely on migrating birds near roadways (McClure, Ware, Carlisle, Kaltenecker, & Barber, 2013). In this study the researchers deployed loudspeakers that emitted artificial road noise in a forest. They tested the impact of noise only, avoiding bias from other factors such as light, vehicle movements, pollution or disturbance by humans. The researchers found that the only important factor reducing the density of birds was the noise emitted from loudspeakers.

The principal objective of the present work was therefore to determine the effect of traffic noise on the numbers, species richness and spatial distribution of birds during the autumn migration period. The null hypothesis to be tested was the assumption that the utilisation of a road by vehicles would not cause the numbers and species richness of birds in the vicinity of that road to drop. In the alternative hypothesis we assumed that, in connection with the negative influence of the road, we should expect changes to the distribution pattern and numbers of birds in the zone directly exposed to such an influence. Moreover, we assessed the influence of traffic noise in the vicinity of the road for habitat utilisation by birds from different feeding guilds (insectivores or granivores). We expected that uneven food resources in the vicinity of the road, human disturbance and anthropogenic food might be reasons for the different locations of the various groups of birds in relation to the road.

2. Methods

2.1. Study area

The field work was conducted in the Janów Forest in south-eastern Poland (N50°41′-27′ E22°17′; Fig. 1). This extensive, closed-canopy forest complex lies on flat terrain, but there are dune hillocks in places. The habitats are mostly coniferous woodland, but alder woods grow in the depressions and river valleys. The principal tree species is scots pine (*Pinus sylvestris*), and to a lesser extent silver birch (*Betula pendula*), oak (*Quercus* sp.), spruce (*Picea abies*) and fir (*Abies alba*). The study was done along the two-lane national road No. 19 between Janów Lubelski and Łążek Ordynacki; the roadway