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Onset of breeding in Tawny Owl *Strix aluco* in eastern Latvia

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Abstract

Factors influencing onset of breeding in Tawny Owl in eastern Latvia were determined by examining time of egg laying in 344 nests during 1991 - 2008. Data on owls breeding in natural cavities and nest-boxes in six districts (Aizkraukle, Balvi, Gulbene, Ludza, Madona, Rēzekne) were used. Capture and ringing of females was performed at 132 nests and morphological parameters and age of the female were recorded. Data on small mammal abundance at the Teiču Nature Reserve (Madona District) and open-access information on weather conditions at the Zīlāni weather station (56° 31' N; 25° 55' E) were used for analyses. Onset of breeding between years varied substantially: the mean date of the laying of the first egg ranged between March 13 (2002) and April 14 (1996). Range of the recorded extremes is even greater: February 20 (2002) and April 30 (1998 and 2001). There was no trend of the timing of the laying of the first egg during the study period of 18 years. Female characteristics (age, weight, wing-length) had no effect on the onset of breeding. Also small mammal abundance had no effect neither in previous autumn, nor in summer of the breeding season. The only two factors having a statistically significant impact were mean air temperature in February (positive effect; $r^2 = 0.38$; $p = 0.008$) and March (positive effect; $r^2 = 0.55$; $p = 0.0005$), as well as depth of snow cover in February (negative effect; $r^2 = 0.53$; $p = 0.0009$) and March (negative effect; $r^2 = 0.51$; $p = 0.0013$). Mean air temperature and snow depth in January had no effect. We conclude that Tawny Owls benefits by warm springs with little snow cover. These factors may explain the range expansion of the species in the past and, probably, future.

Key words: breeding onset, Latvia, range expansion, *Strix aluco*, Tawny Owl.

Introduction

In general bird populations are regulated by available resources in a density-dependent manner (Lack 1954). However, density independent factors (e.g. weather) may have significant influence on density dependent populations (Newton 1998). The evidence for global warming now appears overwhelming (see review by Watkinson et al. 2004). Climatic factors are usually the limiting factors for species distribution, and thus it is predicted that climatic changes will most probably cause a shift in species distribution. Climate change has been attributed to cause changes in the geographic ranges of bird populations in Europe already since the beginning of the 20th century (Kalela 1949). Recently, considerable shifts in species distribution ranges are predicted by complex analyses of climate change impact on habitats in Europe (Huntley et al. 2007).

Onset of breeding is critical for reproductive output of the individual. Too early broods may face increased predation and density-independent mortality by weather extremes, and too late broods may be subject to starvation, when the peak of the food source is over (Verboven, Visser 1998; Blūms et al. 2002; Blūms et al. 2005).

Tawny Owl is resident generalist predator, distributed throughout most of Europe (Hagemeijer, Blair 1997). It is a typical species of deciduous temperate forests of Europe (Mikkola 1983).

This species has expanded its range to the North relatively recently – e.g. the first observation of Tawny Owl in Finland was in 1875, when one individual was shot near Helsinki (Collin 1886). The species has also gradually increased in numbers from rare to common species in Estonia until 1960 (Kumari 1958). In Latvia, currently it is the most abundant owl species with a population estimate of 15000 - 20000 pairs and breeding density on average 27 pairs per 100 km^2 (Avotiņš 2000).

In this paper we discuss factors affecting onset of the breeding in Tawny Owls in the eastern part of Latvia and their potential impact on species expansion in the region in the past.

Materials and methods

Data on the laying date of the first egg during 1991 - 2008 were obtained from 344 nests in nine sample plots located in seven districts (Aizkraukle, Balvi, Gulbene, Ludza, Madona, Rēzekne and Ludza) of eastern Latvia (Fig. 1). The majority of the nests were in nest boxes, but in a few cases also in natural cavities. Nests were checked during late incubation stages indicated by behaviour of the females.

We estimated the laying date by back-calculating the date given the egg's incubation stage, measured by the water test method (Blūms 1990). The time period for a laying an egg is 48 hours and the incubation time for Tawny Owl is 30 days (Mikkola 1983). Incubation is started after the first (or sometimes second) egg has been laid (Mikkola

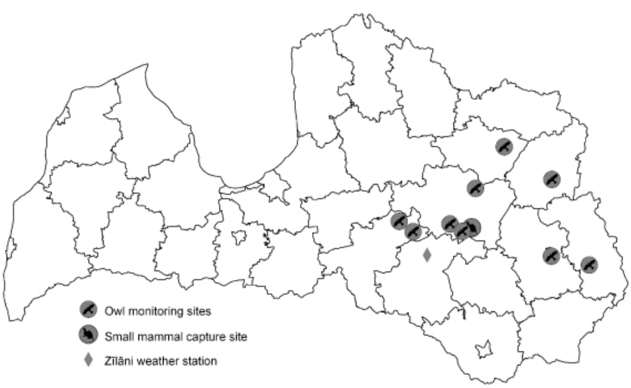


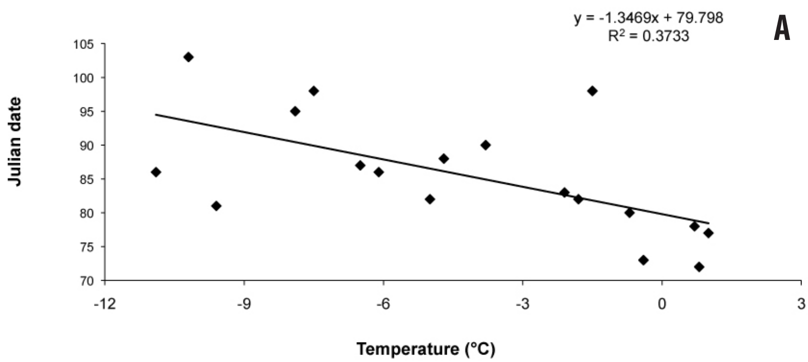
Fig. 1. Geographical location of owl study sites, small mammal trapping site and Zīlāni weather station

1983). In some cases, when the young were already hatched at the time of the first visit, we estimated the laying date also by the age of the nestlings. Young of the Tawny Owl are fledging by the age of 28 to 37 days (Mikkola 1983).

The mean date of the laying of the first egg was determined annually by calculating the arithmetic average of the Julian date of all first eggs laid in the respective year.

Capture and ringing of the breeding females were performed in 132 nests. Females were captured either by netting them at the opening of the nest box (cavity) or by trapping them in the nest box by attaching a swing door to the entrance. Capture was performed during late stages of incubation to avoid desertion of the nest. We recorded female morphological parameters (maximum wing length, tail length, weight) and age by moulting characters (Petty 1992).

Data on small mammal density at the Teiču Nature Reserve were used for analyses. The reserve is located in very close proximity of the Mētriena sample plot with some of the nest boxes placed inside the reserve. Small mammals were snap-trapped in autumn (September) and summer (June) in meadow and forest habitats (Pupila, Bergmanis 2006; A. Pupila, personal communication). Open access data on climate conditions at the Zīlāni meteorological station (56° 31' N; 25° 55' E) were used. Data were analyzed by Pearson product-moment correlation (Zar 1996).



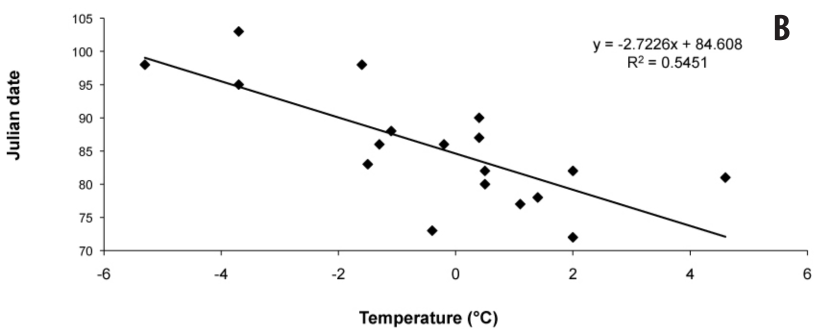


Fig. 2. Laying date of the Tawny Owl in Eastern Latvia explained by the mean air temperature in February (A) and March (B).

Results

The mean onset of breeding of the Tawny Owl in Eastern Latvia (Table 1) ranged between March 13 (2002) and April 14 (1996). Range of the recorded extremes was even greater: February 20 (2002) and April 30 (1998 and 2001). Onset of breeding was not shifted in either direction during the study period of 18 years ($r^2 = 0.007$; n.s.). Mean laying date in Eastern Latvia over the period of 1991 - 2008 was March 28.

Data showed that the laying date of the first egg had not been influenced by the female characteristics: age ($r^2 = 0.005$; n.s.; n = 129), weight ($r^2 = 0.062$; n.s.; n = 132), tail-length ($r^2 = 0.063$; n.s.; n = 112) and wing-length ($r^2 = 0.004$; n.s.; n = 115).

The annual variation in laying dates was not driven by the abundance of small mammals in the field in the previous October ($r^2 = 0.007$; p = 0.76), nor in June of the current breeding season ($r^2 = 0.05$; p = 0.36).

There were only two factors that had a statistically highly significant impact on the laying date of Tawny Owls in eastern Latvia: temperature and snow depth. Increased air temperature in February (Fig. 2A) and March (Fig. 2B) caused earlier onset of breeding, as expected. In contrast, increased snow depth in February (Fig. 3A) and March (Fig. 3B) delayed the onset of breeding. Mean air temperature and snow depth in January had no effect.

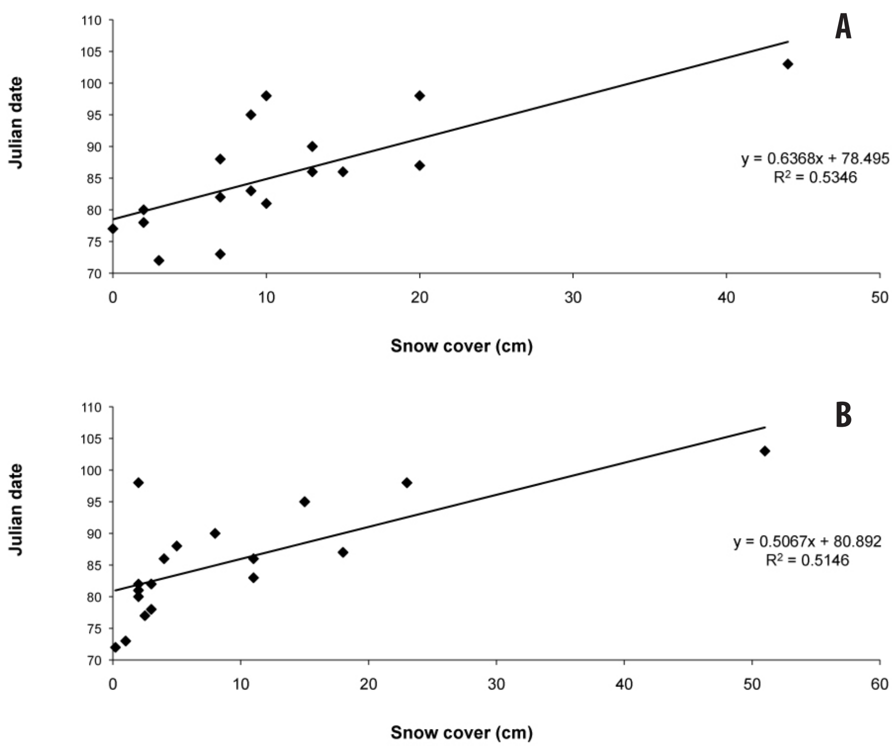


Fig. 3. Laying date of the Tawny Owl in Eastern Latvia explained by the depth of snow cover in February (A) and March (B).

Table 1. Laying dates of the first egg by Tawny Owl *Strix aluco* in eastern Latvia in 1991 - 2008

Year	Median laying date	Range	Nests studied (number)
1991	23 March	14 March - 2 April	11
1992	23 March	16 March - 30 April	12
1993	24 March	3 March - 8 April	24
1994	27 March	17 March - 6 April	15
1995	19 March	6 March - 31 March	22
1996	14 March	4 April - 26 April	23
1997	14 March	2 March - 27 March	17
1998	9 April	28 March - 30 April	12
1999	28 March	4 March - 2 April	20
2000	21 March	6 March - 2 April	15
2001	29 March	11 March - 30 April	18
2002	13 March	20 February - 24 March	29
2003	27 March	19 March - 4 April	19
2004	1 April	19 March - 4 April	25
2005	9 April	31 March - 27 April	19
2006	6 April	1 April - 15 April	15
2007	22 March	10 March - 30 March	22
2008	20 March	8 March - 3 April	26

Discussion

Onset of breeding of Tawny Owl in Eastern Latvia between years varies widely (Table 1). There is no trend to become earlier or later as described for other species e.g. onset of breeding in Pied Flycatcher is coming later in Finland (Laaksonen et al. 2006) and in Great Tit earlier in Germany (Winkel, Hudde 1997). It is probable that our data series are too short (18 years) to detect any considerable change in onset of breeding. As a resident species, Tawny Owl might respond quickly to changes in spring phenology, but the response to climate change can be expressed in other ways. The response to climate has been has been observed to differ in different populations of a single species (e.g. for Great Tit see Visser et al. 2003). However, a northwards range shift is the most common observed consequence of climate change for all taxa (Parmesan, Yohe 2003).

Climate change has been causing and is predicted to cause various ecological effects on avian species (Winkler et al. 2002) and ecosystems in general (McCarty 2001). The most serious concern raised is asynchrony between bird breeding time and the availability of food resources (Visser et al. 1998; Both, Visser 2001), particularly for long-distance migrants feeding mainly on insects (Sanz et al. 2003). However, food availability shifts might not be applicable to owl breeding time. The main food source of owl populations in Northern Europe is voles (Sundell et al. 2004). It is predicted that vole populations are much more numerous in autumn in comparison to spring, thus food availability in theory increases during the season. Early breeding in owls might provide other advantages unrelated to food (e.g. young have to acquire hunting skills before winter). However, food has been documented as an important factor for other parameters of owl breeding (Brommer et al. 2004).

Tawny Owls breed also in cities, which can begin as early as in December (Petriņš 1986; O. Keišs, unpublished data). The factors determining the early onset of breeding in the urban environment remain unclear. Possible explanations are (i) availability of food in towns since rodents and small passerines accumulate in suburban areas in winter; this idea has been supported by Petriņš (1986); (ii) temperature – mean air temperature is higher in cities; (iii) light conditions – anthropogenic light sources in cities might mislead birds on onset of 'spring' by an altered photoperiod. Probably, the same factors are responsible for onset of breeding of this species also in the wild environment. Our observation that a deep snow cover delayed onset of breeding, might be indirectly related to the availability of food, as voles and mice are difficult to capture under snow. Thus breeding begins when snow disappears.

In other studies female age has been found to have an indirect effect on reproductive output by earlier breeding of older females (Blūms et al. 2002). Thus, we might expect older females to start to breed earlier. This seems reasonable if early breeding individuals gain more fitness than late breeders. In our study, however, female age had no effect on onset of breeding.

Female body mass in our study had only a slight (statistically insignificant) effect on the onset of breeding of Tawny Owl. Size-adjusted body mass adjusted to wing length in birds would have been better measure of female condition to consider for effect on onset of breeding.

We conclude that the Tawny Owl benefits from warm springs with little snow cover. These climatic factors might have an indirect effect on food availability, as snow limits access to rodent prey and thus may delay onset of breeding. Global warming thus might have driven the gradual increase from rare to common species status in Estonia until 1960 (Kumari 1958; Leibak et al. 1994). The further colonisation forecast for the late 21st century distribution includes mainland Europe up to the Arctic Ocean (Huntley et al. 2007).

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