Can clutch size and survival rate in great tit and blue tit be determined by the timing of breeding?

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Introduction

Previous studies have shown that timing of breeding is affected by different time-dependent /seasonal triggering factors in great tit and blue tit (1; 2). The aim of this study is to see if clutch size and survival rate could be explained by the seasonal timing of breeding; date of nest building, egg laying, clutch size, hatching time, survival rate, nest failures and ambient temperature.

Background

Area: Arboretet in Fana, Bergen.
Sampling time: 21. April-09. June 2017
Monitored species:
Family: *Paridae*.
Order: *Passeriformes.*
Specie: Great tit (Parus major)
Blue tit (Cyanistes caeruleus)

Picture of great tit (Parus major) and blue tit (Cyanistes caeruleus), the two species observed in this study.

Method

34 nest boxes was set up at four locations around Arboretet in Fana, Bergen. Timing of breeding of inhabited nest boxes was studied through monitoring of nest building stages, egg laying and hatching time. Clutch size, survival rate, and nest failures was also recorded. Nest boxes was checked once every week from 24.04.2017 to 25.06.2017. Analyses concerning survival of total clutch, clutch size against initial date of egg laying, survival and mean ambient temperature against initial date of egg laying and mean ambient temperature during post-hatching period against the initial date of hatching was performed in R.

Location and placement of nest boxes at the Arboretet in Fana, Bergen. *Nestbox 1-8 was placed at the Japanske hage; site 1. Nestbox 9-17 was placed by Mørkevatnet; site 3. Nestbox 18-20 and 33-34 was placed at Blondehuset; site 2. Nestbox 21-32 was placed at Brandaneset; site 4*

Results and conclusion

The correlation between start date of egg laying and temperature (Figure 2) implies the presence of an energetic limitation for laying eggs early (3). This could be explained by the fact that heat loss during incubation is roughly 3 times greater than the heat loss incurred at the resting metabolic rate of a non-incubating bird (4).

There seems to be a relationship between temperature and survival of the brood (Figure 3), this is compliant with Vleck (5) who discovered that incubation for blue tits requires the additional heat when the air temperature falls below the lower critical value of the thermoneutral zone (For blue tits = ~15°C). However, analysis suggests that there are other factors that also affect survival (GLM = 1.379; P=0.168). Results could suggest that blue tits enact a synchronization change mechanism (6) in clutch size as a response to temperature.

Fitness is dependent on timing of breeding because the greatest survival rate is related to food abundance and availability (6). There seems to be a relationship between survival and date of laying (Figure 1B), however, other parameters also control this reaction (GLM=1.513; P=0.130). For example, food availability. Even though the nestling cycle of a blue tit is highly flexible (7) the timing of laying is critical as the pupation cycle of a caterpillar is influenced strongly by ambient temperature (8). Therefore, parents feeding late broods may struggle to find enough food.

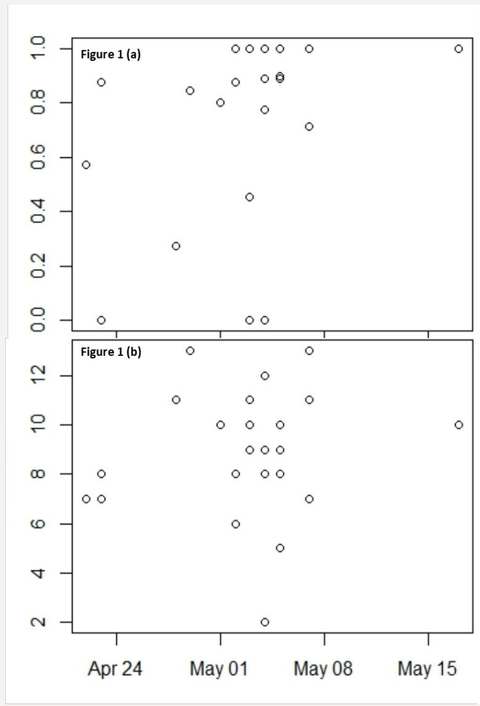
Limitations

There are a few limiting factors that are compromising our results. The data analysed is only sampled this year. Having no comparable data from previous years makes it hard to predict a trend. There is also no control group. We lack information/data on other possibly contributing factors as abundance/absence of food, nest temperature, nest soaking, parental abandonment, predation, parasites and sickness. There is so data concerning the general breeding densities or brood productivity for the two species in the area.

Hatched chicks from nest box monitoring at Arboretet, Bergen.

Recommendations

According to many studies seasonal peaks in food abundance have changed in recent years owing to higher spring temperatures (9;10;6). Further analysis is important and recommended to understand how climate change will affect brooding cycles of tits.



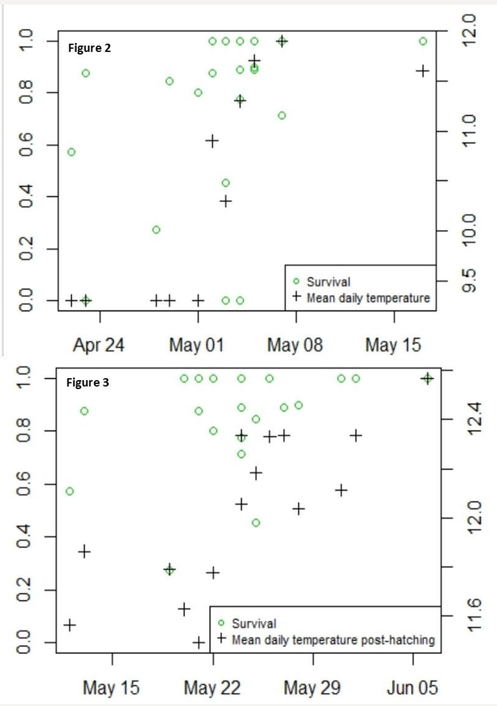


Figure 1: Integrated plots of (a) Survival of total clutch (b) Clutch size against the initial date of egg laying. *Survival is a function of the total clutch and measured as a binomial (1 = all clutch survived, 0 = none of clutch survived). Majority of nesting occurred during start of May.*

Figure 2: Multi-variable plot of survival (left hand y-axis) and mean daily temperature (right hand y-axis) against the initial date of egg laying (x-axis). *Mean temperature was measured over a 24 hour period on the initial date of egg laying. It was measured in degrees Celsius. Majority of nesting occurrences correlated with rise of temperature during early May. Variation in the survival rate decreased during this period, with maximum survival rates first occurring in clutches laid during this period*

Figure 3: Multi-variable plot of survival (left-hand y-axis) and mean daily temperature during the post-hatching period (right hand y-axis) against the initial date of hatching. *Mean daily temperature was measured over 15 days post-hatching. It was measured in degrees Celsius. There is a visual positive correlation of mean daily temperature with initial date of hatching. Survival rate is also highest in clutches that hatched later in May, with a smaller variation in survival in later hatching clutches.*

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PIctures of great tit, blue tit and location was created and obtained from Sigrunn Eliassen.

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