

Bird's nests are characterized by a great diversity, and even within the same species and within the same populations, a large variation of their size could be observed. It seems that this variability is connected with many factors. The most important considered is the pressure of predators – for them it may be easier to find larger nests, although recently it has also been pointed out that the size of the nest may be a kind of signal reflecting the quality of birds from a pair. As the nest serves as a protection for laid eggs and growing nestlings, it should be obvious, that characteristics potentially contributing to maintaining the proper temperature seem to be particularly important. However, many studies did not confirm relationship between nest variables and aspects related with thermoregulation. It may be related to the methodology used in these works, as in the nest size analyzes, all its dimensions were not taken into account (mainly mass and height), but especially important seems to be a nest cup as its size may affect the rate of cooling the eggs. Now new methods and tools allow research at a much more accurate scale.

During incubation, especially in birds where only one sex is involved in this behaviour, it is possible to clearly distinguish the periods spend in nest (so called on-bouts) and the periods when the bird leave the nest to forage (off-bouts). It should be assumed that this pattern may be affected by the nest characteristics - good nest insulation parameters should cause longer periods of the birds' stay in the nests, because their energy expenditure will be lower. Also, the periods that the bird spends away from the nest can be longer, as a nest with better isolation properties should provide better protection of the eggs against cooling down. Previous work analyzing the incubation used very coarse analyzes - measured how many days elapsed from laying the last egg to hatching the chicks.

Better nest insulation properties should cause not only changes in the incubation pattern itself, but also decrease incubation costs for the birds, which should manifest in their better condition at the initial stage of chicks rearing period or decisions related with the second brood. This project linked research dealing with on the nest itself with those related to incubation of eggs, as existing data leads to the hypothesis that the characteristics of the nest (including the size of the nest cup, the thickness of its walls and bottom, its mass, density and materials used for construction) affect the incubation pattern, and also affects birds' costs associated with the incubation stage of breeding. Recently developed methods of registering the incubation behavior of birds and the insulating properties of the nest itself will allow to test it.

In this project I will focus on nests built by the Great Tit in nest boxes. At the beginning of the incubation nest will be measured (including the size of the nest cup, the thickness of the walls and bottom) and weighed. Next, using the temperature loggers inserted into the nest (beneath the nest cup), the incubation pattern will be recorded – the number and duration of the sessions on nest for eggs warming and the periods that the female spends outside the nest. During the incubation the nest will be replaced with artificial ones (from moss and cotton wool, similar to this used by birds), and its insulating properties will be determined – on the basis of the cooling rate of the heated temperature logger. After measurements, the nest will be replaced again. After young will hatch, the nest will be replaced by artificial one again, taken to the laboratory and sorted into groups of nest materials. Incubation pattern will be correlated with the characteristics of the nest (mass, dimensions, materials used for construction) and insulating properties.

Additionally, experiments will be carried out in which the size of the nest and the amount of materials used for its construction will be manipulated, by adding or removing the moss that forms the base of the nest. The females' costs of incubation will be examined by analyzing its condition at the initial stage of feeding the chicks and the frequency and results of the second brood. Those data will be also related to nest characteristics, incubation patter and nest insulating properties.

The topics related to nests and their various functions have been developing particularly intensively in the last decade. The studies of relationship between incubation and the nest itself, its characteristics, materials used for its construction etc., although it seems obvious, is a new issue and still not well studied. New technical possibilities open new perspectives for research and analysis at a much higher resolution level (like daily incubation pattern). The subject of proposed project is intensely explored recently; experimental work is planned there, and the lack of data collected in such a way is indicated in the literature. Research will be conducted in other latitudes than before, where birds can be subject to other selection forces, and it should be remembered that the nests themselves (their characteristics, composition of materials used, etc.) are variable depending on the e.g. climate of the area.