The role of acoustic communication networks in spatial orientation: the case of the corncrake (*Crex crex*)

The main goal of the project is to assess the usefulness and application of acoustic maps for birds' spatial orientation in conditions of limited visibility. Acoustic maps are sets of objects producing sounds, constant in time so that their position can be memorized and used to orient relative to them even in zero visibility. The project concerns the problem of general importance, because in principle all animals must orient in conditions of limited of visibility, at least occasionally. Studies on spatial orientation based primarily on acoustic transmission have been conducted over the years, but they concerned only adaptations to very specific conditions like for example caves or depths. Not many studies have focused on a broader phenomenon, in which animals use simple sounds to orient themselves and locate objects in conditions of poor visibility.

The spatial orientation of most birds is based on vision, yet many species are active mainly at night, so they additionally have to make use of sounds for orientation. Nonetheless, the interest of scientists in this important part of birds' and not only birds' life is surprisingly small. Except for a few species of oilbirds and swifts, living temporarily in caves, and having a quite rudimentary ability to echolocate, and owls being able to locate precisely the sounds, adaptations of birds to spatial orientation with the use of sounds are poorly understood. At the same time, there are many mechanisms of spatial orientation using sounds. In many birds, males occupy territories within a short distance from each other, forming clusters in the form of honeycombs. In these clusters, each individual defends its territory against neighbours, announcing its presence by singing. These complex spatial arrangements of individuals create communication networks, in which individuals communicate with each other and eavesdrop on each other. However, in addition to the communicatory function, sounds provide receivers with a more or less precise information about the location of the sender. Therefore, it seems plausible that birds improve their spatial orientation in conditions of limited visibility, using voices of neighbours as acoustic maps.

This project is planned for three years and it will be based on observational and experimental research on communication networks of the corncrake (*Crex crex*). Corncrake is a territorial species living in loose groups and having a very simple system of vocal communication. In recent years, due to the increased power of computers, it has become possible to analyse not single interactions but entire communication networks. Using innovative manipulation techniques and novel bioacoustical hardware and software, it has become also possible to create artificial communication networks and to carry out detailed analyses of various phenomena within networks. I plan to make two series of experiments based on natural communication networks of the corncrake and artificial networks, in which individuals will orient relative to a set of remote speakers, broadcasting calls and imitating a network of real birds. The analysis of the focal bird's moves depending on the arrangement of speakers creating an artificial communication network, will explain how the structure of a network and acoustic parameters of calls influence spatial orientation of individuals in natural conditions. As a result, this study should extend our understanding on how animals perceive, process, and use sounds while orienting in space and locating objects in conditions of poor visibility. Thus, this project should contribute to our knowledge about behavioural adaptations to life in conditions of poor visibility.