

Animals living in the same ecosystem compete with each other for resources (e.g., food, water, shelters, mates), both at intraspecific as well as interspecific level. The interspecific competition is one of the ecological process, which affects animals community structure and leads to develop various strategies and adaptations (anatomical, behavioural, physiological) that may give some species advantages over their competitors.

Many terrestrial animals, including insects, amphibians, birds and mammals use acoustic signals in communication. Communication is a process, in which a sender intentionally transmit information to a receiver to modify its behaviour. All vocalising animals coexisting in the same ecosystem propagate their acoustic signals throughout a locally-specific acoustic environment. The acoustic properties of the environment are shape both by vegetation structure, which is a basic frame for acoustic communication space, and by sounds (biotic and abiotic) present within the environment, and interactions between vocalising species. The acoustic space, is determined by three axes: (1) frequency range, in which acoustic signal is distributed, (2) amplitude (or loudness) of the sound and (3) time in which signal is broadcasted.

Interspecific competition for acoustic space have been rarely studied in the past. Most of the studies examining this ecological process have been concentrated on the competition between closely related species or very narrow and specific group of species, and focused on short period of time in the breeding season or during a day (usually a dawn chorus, when most of the bird species singing in the same time). Therefore, it is not clear how various animal species compete with each other for acoustic space, which mechanisms and strategies particular species developed or who is the winner and loser in such interspecific competition?

In my project I would like to focus on interspecific competition for acoustic space in birds, have regard to the effect of all vocalising animals inhabiting particular environment. The main research question of the project is whether and how various species of birds compete with each other as well as with other groups of animals for acoustic space? I predict, that to ensure effective communication and avoid acoustic overlap the following strategies may evolved: (1) spatial separation (similarly vocalising species occupy spatially-separated locations - interspecific territoriality), (2) temporal separation (similarly vocalising species produce their vocalisation during different part of a day or are vocally active during different part of the year - do not vocalise in the same time), (3) spectral (frequency) separation (species avoid noise in their own song frequency range and do not vocalise when their frequency range is occupied by other sounds), (4) spectral adaptation (species adjust their song to the actual noise in their frequency range and change frequency of the signal or use song type which is less masked by noise).

To examine above mentioned hypotheses autonomous sound recorders will record the soundscape during whole breeding season in three locations: boreal, temperate and tropical forest. Selected locations differ fundamentally in available acoustic space for birds (various duration of daylight and breeding season, different intensity of vocalisation by other than birds animals), but also in ecology of inhabited them species, what will enable to show different strategies and competition models to find optimal acoustic niche. The recordings from autonomous sound recorders will enable to describe when particular species sing in the background of sound of other animals (including birds), and why do this exactly in this way. Additionally, the playback experiments will be conducted, to experimentally support (or rebut) proposed hypotheses. During the playback experiments, appearance of acoustically new species, which will be competed, in various range, for acoustic space with local species, will be simulated. The behavioural response, including acoustic, of tested individuals will be observed and analysed.

To the best of my knowledge, the current research proposal is the first comprehensive approach to study the competition for acoustic space in birds. The results of the project will enable to know, how between-species interactions shape acoustic signals, and better understand the evolution of acoustic signals, which are both under intraspecific and interspecific selective pressure.