In 1966, Robert T. Paine has introduced the keystone species concept, i.e. identification of an organism that affects ecosystem in greater extent than expected from its relative abundance or biomass. This phenomenon has been observed over the time in a range of ecosystems and organisms and prompted Paine to paraphrase Orwell's famous quote that some species are more important than others. Nowadays, the species keystoneness is well established principle, important for both ecology and nature conservation practice. However, there is an emerging concept: the existence of keystone ecological structures, i.e. habitat components (*sensu* physical objects) that affect community or ecosystem in greater extent than would be expected from their relative abundance or biomass.

Twenty seven years after Paine's concept, in 1993, Michael H. Hansell in his essay review argued that bird nest has potential to constitute a biological object that has significant influence on ecosystem functioning. Although, he has accurately diagnosed the concentration of resources in the form of nest material and food as a fundament of ecological importance of nest, this concept remains not developed up to date. In consequence, empirical evidences that bird nest may influence ecosystem functioning and affect near nest habitats and organisms are missing. The idea is still appealing, since bird nest as one of the most fascinating and inspiring creation of nature is first and foremost ecological structure that has high potential of keystoneness. Tree cavities are often identified as key resource in woodlands. Strong relationships between existing cavities and primary or secondary nesting birds led to formation of so-called 'nest webs'. However, other organisms that rely on woodpecker-excavated cavities and significantly influence ecosystem functioning (i.e. bacteria, fungi, invertebrates) remain severely understudied. Also open cup nests may constitute a biodiversity hot-spots and influence ecosystem functioning. However, the role of bird nests as keystone structure has not been addressed up to date. Concentration of resources in the form of biological materials and energy investments in construction and incubation as well as social information available via nest presence/use attracts or repels other species and, in turn, influence directly or through cascading effects species richness, diversity and abundance of co-occurring organisms over larger spatial scales.

Twenty seven years after Hansell's essay, this project will test the concept of keystone structures and investigate the role of bird nest (open cup and cavities) as a driver of biodiversity and ecosystem functioning. The entire project is divided into four work packages addressing specific research problems. (1) Mycobiota, physiochemical properties and biochemical activity of substrate present/deposited in woodpecker-excavated cavities will be evaluated and compared to cavity-free parts of the trunk. (2) Microbiome (fungi/bacteria), physiochemical properties and biochemical activity of substrate present/deposited in open cup nests of forest-dwelling large-bodied birds and in soil affected by the nest presence will be evaluated and compared to control plots located in near and far nest habitats. (3) The relationships between biological processes running in biomass accumulated in nest construction and birds' incubation activity will be related with reproduction success. (4) Spatial patterns in species richness, diversity and abundance of insects, birds, bats and terrestrial mammals at near nest habitats will be investigated and compared to control plots. Since this is highly multidisciplinary research, each work package is constructed as a team work, involving the activity of several collaborators, experts in the field. This study combines multiple research methods, including cultivation and DNA-based identification of fungi, investigation of microbiome with NGS-based metabarcoding, evaluation of physiochemical composition of nest substrates and soil samples, evaluation of enzymatic activity within nest substrates and soil samples, sampling of invertebrates, surveys of forest-dwelling birds, bats and terrestrial mammals and behavioral observation of birds. The research will quantify the influence of keystone structures on the spatial differences in biodiversity of complex forest ecosystem. We also expect to provide evidences that bird nests constitute a genuine keystone structures which have significant role in ecosystem functioning. This project will also contribute to the practice of nature conservation and add to ongoing debate on the high conservation value of trees bearing woodpecker-excavated cavity and deserted nests of large-bodied birds.