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SYMP05: Ecological factors of evolution: links among behavioural ecology, community ecology, and speciation in birds

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Evolutionary ecology is one of the most important areas of evolutionary studies. Researches in behavioural ecology, community ecology and ecomorphology have resulted in better understanding of ecological factors of microevolution and speciation in birds. Recently the significance of ecology in evolutionary studies has been gradually enhancing due to essential development of the ecological niche concept. According to current views the ecological niche of birds is considered as an integrated functional unit. The niche is defined as a system which integrated properties are determined by species-specific function of species in ecosystem and expressed in species-specific foraging behaviour of birds. For successful fulfilment of the function, i.e. searching for and capture prey by specific methods, birds have acquired various hierarchically subordinate ecological, morphological, physiological and other adaptive characters. Therefore, the niche theory plays a linking role in development of various evolutionary-ecological studies.

In this symposium papers on behaviour ecology, community ecology, theory of ecological niche, and ecomorphology of birds are presented. Links among different areas of evolutionary ecology are discussed in order to elaborate common approaches to study the ecological factors of evolution in birds.

SYMP05-1 Relative size of four parts of brain in Anseriformes and some ecological variables

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In scientific publications there are a lot of studies concerning the relation between brain weight and body weight of birds, attempting to combine the relative size of brain with various behavioural and ecological classifications. However, there are not many information on the size of brain parts of anseriform birds. Nevertheless, there are justifiable premises indicating more distinct enlargement of appropriate parts of brain in relation to bird's foraging mode and diet. For comparative studies 173 brains of 17species were gathered, divided macroanatomically into four parts: hemispheres (H), cerebellum (C), truncus cerebri (TC), and optic lobes (OL), and then the relative sizes of those parts expressed as a percentage of brain weight, E – encephalon, (respectively H/E, C/E, TC/E, OL/E) were established. The analysed birds represent 4 tribes: Anserini, Anatini, Mergini, and Aythyini. The mentioned bird tribes represent 4 different foraging modes (browsing, dabbling, deep diving, and shallow diving). The comparisons were made both within the tribes and between them. Many significant differences were noticed on the basis of the variance analysis. The bird species within the tribes of Anserini and Mergini differ in all indices, in the Aythyini tribe – only in TC/E index, and in the Anatini tribe no differences were reported. The tribes differ from each other in 3 indices: LO/E, C/E, and TC/E. In all studied anseriform birds the species that dive the best and feed on fish or invertebrates, which is those belonging to the Mergini tribe, have the largest relative size of optic lobes and cerebellum.

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SYMP05-2 Correlations of foot sole morphology with locomotion behaviour and substrate in four passerine families An example of parallel evolution

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In a previous study, I described a significant morphological convergence in coniferous specialists across 7 phylogenetic passerine lineages. This convergence was found in body mass and the shape of the digital pad on the hind toe. Therefore, I expected to find that foot sole morphology correlates with substrate use and bipedal locomotion behaviour within different passerine families.

Pictures of the feet of live birds belonging to 37 species from 4 families were made and the digital pads and furrows were geometrically abstracted. Geometrically abstracted mean foot prints per species were compared with substrate use and locomotion behaviour. These ecological factors were obtained by questionnaires sent to species experts. Correlations between the ecological and morphological variables were obtained by proportional odds regression models.

As expected, I found good correlations between foot sole morphology and both substrate use and bipedal locomotion, but a poor relationship between foot sole morphology and other locomotion types. For example, the length of the proximal hind toe pad is negatively correlated with sideways position of the body and hanging upside down. Or, in birds that often use vertical structures, this pad is symmetric, broad and has a distal maximal width. The functional aspects of these correlations and the adaptive function of the foot sole to locomotion and substrate are discussed.
I could find patterns of parallel evolution in foot sole traits by comparing the specialists in substrate use or locomotion behaviour with the genus' mean foot sole in four distantly related families.

SYMP05-3 The competition for broadcasting time versus the social facilitation: are there any coordination rules in the multi-species avian chorusing?

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The simultaneous singing of a number of individuals belonging to the variety of avian species is well known but still poorly known phenomenon. At least two different modes of interaction between the singers were supposed previously: the competition for broadcasting time causing the separation of the acoustical niches and the social facilitation leading to acoustical convergence along the time axis. According to our observation on the willow shrub meadow during the early morning up to 85% of time was filled with avian singing. Up to 6 different singers were recorded to vocalise within each 15–s interval thus creating a background for the competition for interference-free broadcasting time. The sharp difference in the seasonal and daily routines of the singing between the coexisting avian species could be treated as the way to reduce the interspecific acoustic interference. Although the breeding territories belonging to the pairs of different species overlap freely the study of distances between the singing posts of simultaneously vocalising males shows that they apparently avoid to sing at the distances less then 10–15 m. We perform also the time-series analysis of the chorus singing of the members of partly isolated settlements of shrub meadow birds. The total vocal ac-

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tivity of such choruses normally posses a clear rhythmic organisation thus providing some support for the hypothesis of the social facilitation.

SYMP05-4 The structure of reed warblers (*Acrocephalus* spp.) community on the estuaries of Southern Russia

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In 2001–2002 the study of the communities of reed warblers (*Acrocephalus,* Sylviidae, Aves) was conducted on the estuaries of Tchelbas River not far from the See of Azov. In terrestrial habitats *A. schoenobaenus* and *A. agricola* breed on the wet meadows covered with sparse reeds and tall grass (near water edges). Also *A. scirpaceus* occur in small number in this habitat strongly preferring the best developed reed beds. Much more complex situation occurs on the flooded areas covered with cattail (*Typha angustipholia*) and reed stands. *A. agricola*, *A. scirpaceus, A. melanopogon*, and *A.arundinaceus* (but not *A. schoenobaenus*) breed here in substantial number. The habitat differences between the species was extremely low. In particular *A. agricola* and *A. melanopogon* are similar with respect to their habitat requirements. Both species breed in well developed cattails usually with a small mixture of reeds which are used by males for singing. Also a number of *A.scirpaceus* breed in cattails but this species is confined to reeds much more closely then *A. agricola* and *A. melanopogon* are. The same is true for *A. arundinaceus.* The attachment of this species males to the reeds is even more pronounced but a substantial number of females still place their nests in cattails. During the last three decades the reeds on Tchelbas estuary was largely displaced with cattails that influenced the local reed warbler community. The available data show the substantial increase in the number of *A. agricola* and *A. melanopogon* but partial decrease in the number of *A. arundinaceus* in consequence of the changes in emergent vegetation. While the habitats and breeding territories of coexisting reed warbler species were found to overlap widely much more pronounced difference occurs in the time of their breeding and especially in the seasonal periodicity of their singing.

SYMP05-5 Unidimensional hierarchical model of ecological niche in birds

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Theory of ecological niche plays an important role in evolutionary-ecological investigations. It serves as theoretical basis for community organization research. On the other hand, it enables to reveal specific behavioural, ecological and morphological features of organisms and, therefore, promotes the evolutionary studies. Current research in behavioural ecology, ecomorphology, and community ecology of birds have resulted in better understanding of nature of ecological niche and creation of unidimensional hierarchical model of niche. In the model the foraging behaviour of birds is considered as the universal parameter which describes the ecological niche of species as a functional unit inside a community. Foraging behaviour expresses in integrated form various ecological, morphological and other specific characters of organisms. This regards the ecological niche of birds

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as a system and leads to effective study of many ecological and evolutionary questions. The unidimensional hierarchical model of niche receives the increasing recognition in ornithology and has been gradually replacing the Hutchinsonian multidimensional model of niche. In the result of development of the theory of ecological niche, the community ecology researches pass on a qualitatively new level – from the description of structure of communities to analysis of mechanisms of their formation and functioning.

SYMP05-P1 Morphometry of gut in long-tailed duck *Clangula hyemalis* wintering in the Polish Baltic coast

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The material for the research was guts of 140 individuals of the long-tailed duck *Clangula hyemalis* – 87 males (9 young and 78 adult individuals) and 53 females (13 young and 53 adult individuals) obtained in autumn-winter seasons of 1993–2000 in the western part of the Polish Baltic coast. The following morphometric characteristics of gut were analysed: duodenum length (DL), combined jejunum and ileum length (JIL), small intestine length (SIL), combined terminal intestine and cloaca length (TCL) and combined length (CBL) and weight (CBW) of both caeca. In the analysis the birds' sexes and ages were taken into consideration, as well as their body sizes characterised by three measurements: body weight (BW), body length (BL), and sternum length (SL). Ontogenetic differences in the analysed morphomertric characteristics of the gut were more visible in the group of males than in the group of females, but young drakes were characterised by bigger average values of SIL and CBL than adult individuals of this sex. Apart from two parameters – CBL and CBW – the sex dimorphism was proved in body sizes and the gut measurements – those parameters had bigger average values in males than in females. No such differences were noticed in respect to relative parameters' values: DL, SIL, and TCL expressed as a percentage of body size. In case of three gut measurements, JIL, CBL, and CBW, no relation to any parameters characterising long-tailed ducks' body size was recorded. No relevant relations between SIL and JIL and the measurements of CBL and TCL were noticed.

SYMP05-P2 Prey handling behaviour of hybrids – evolutionary implications

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Common and black redstarts (*Phoenicurus phoenicurus*, *P. ochruros*) regularly interbreed in the wild and produce viable and fertile offspring. However, the isolation barriers which prevent extensive gene flow between these distinct species are unknown. I studied prey handling time and efficiency in F_1-hybrids and parental species in captivity. All birds changed their prey-handling mode with increasing prey length. Handling time was a positive function of prey length. Hybrids appeared to be intermediate between common and black redstarts. Handling efficiency decreased with increasing prey length and was determined largely by individual and family effects. These results imply that prey handling behaviour is not maladaptive in F_1_hybrids and does not impede gene flow between common and black redstarts in the wild.

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SYMP05-P3 Patterns of sex ratio variation in black-headed gull (*Larus ridibundus*)

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Life-history theory predicts skewed offspring sex ratios in a range of situations in which the costs and benefits of producing the sexes differ. Recently many studies reported empirical evidence indicating that animals with chromosomal sex determination adaptively adjust their offspring sex ratio. Variation of primary sex ratio was studied in 294 black-headed gull (*Larus ridibundus*) chicks in 133 nests using a polymerase chain reaction-based molecular DNA technique. The primary sex ratio of the population did not depart from expected binomial distribution. For tests of factors potentially correlated with sex ratio was used GLMMs in SAS (LITTEL et al., 1999). Hatching sex ratio was negatively correlated with egg-laying sequence ($F_{2,157} = 5.81$, $p = 0.004$) and timing of breeding ($F_{1,118} = 4.92$, $p = 0.028$), but no correlation with egg volume ($F_{1,145} = 0.03$, p = ns) was observed. The data indicate that the adaptive allocation of sex by the female to specific eggs in clutch occurs. This study provide the first evidence for adaptive sex allocation in gulls.

SYMP05-P4 Nest defense in ducks

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Nest defense in response to a human by *M*allard (*Anas platyrhynchos*) and pochard (*Aythya ferina*) was studied on the Krotovaya Lyaga Lake, in Western Siberia, Russia, between 1983–2002. Data were collected from 610 mallard nests and 259 pochard nests. We observed defense behavior of incubating females during researcher approached the nest on the boat or on foot and included in analyses only data from first visits to nests. Scores flushing distance and composite nest defense indices (including down concealment the clutch, defecation by a flushed female, distraction displays) significantly increased as incubation progressed in both species. These variables were dependent on nest location. They were the lowest in mallards nesting far from water, independently of vegetation cover of nests. Maximum scores were in mallards and pochards breeding in the artificial nests. Behavior of ringed females was constant from year to year. Flushing distance at second half of incubation period decreased with increasing clutch size of pochards. Nest defense score was higher in mallards than in pochards and mallards also performed distraction displays more often. These differences may evidence that nest defense in dabbling duck and diving duck evolved in various directions.

SYMP05-P5 Structure of ecological niche of willow tit (*Parus montanus*, Paridae, Passeriformes)

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Development of the Grinnelian unidimensional hierarchical niche concept and elaboration of adequate methods of foraging behaviour observation and analysis have promoted the integrated de-

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scription of ecological niche of birds. In the given concept foraging behaviour of birds is considered as an integrated parameter characterizing the functional role of species in the community and synthesizing in itself many other particular niche parameters. The comparative study of behaviour and ecology of willow tit in different points of its geographic range and in different seasons of the year has revealed the specific ecological traits and allowed to describe the integrated structure of ecological niche of the species. willow tit occupies a broad niche. It inhabits various habitats, feed in different species of trees and in all parts of tree canopies, uses broad spectrum of food, and has diverse foraging behaviour. That determines the specific place of willow tit in the natural communities and causes its broad habitat and geographic distribution.

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