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Poster Abstracts

P01: Section: Development and Physiology

P01-1 Wulst area in pied flycatcher (*Ficedula hypoleuca*) nestlings: neuronal organization and development.

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Nissle-stained sections of pied flycatcher brain were used to study neuronal organization of the higher representation of thalamo-fugal visual projection – Wulst area – in 13-day-old nestlings capable of patterned vision and in 6–day-old nestlings capable of only diffuse photosensitivity. In a brain of 13-day-old nestlings, four clearly distinguishable layers were selected: hyperstriatum accessorium (HA), nucleus intercalatus hyperstriatum accessorium (IHA), hyperstriatum intercalatus superior (HIS), hyperstriatum dorsale (HD). Wulst of 6-day-old nestlings revealed three layers – HA, IHA and HIS, while HD has not yet been differentiated from underlying hyperstriatum ventrale. IHA layer is well developed in birds with binocular vision and is not present in birds with two separate visual fields. In 6-day-old nestlings, from all Wulst neurons IHA neurons were the most mature as judged by their nucleus-plasma ratio. It is suggested that the accelerated development of IHA in the young at the stage of diffuse photosensitivity is essential for the future food-acquisition behavior based on the precise localization of moving prey. Supported by RFBR. Grant # 02–04–48290a.

P01-2 Development of the basilar papilla and brainstem auditory nuclei in birds with different types of ontogeny

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Maturation of the cochlear auditory epithelium and brainstem auditory nuclei in birds with different types of ontogenesis: *Gallus gallus*, *Larus argentatus*, *Asio otus* and *Ficedula hypoleuca* – were studied in their relation with the development of the early acoustically-guided behavior. Scanning electron microscopy of the auditory epithelium revealed both common (initial apical-basal and later – basal-apical developmental gradients, regular changes of hair cells' orientation, delayed development of the tall hair cells as compared with the short hair cells in all species) and species-specific patterns of the detailed differentiation of the tall hair cells and regularities in heterohronous maturation of papilla basilaris. Cytoarchitectonic development of *n. magnocellularis*, *n. angularis*, *n. laminaris* and *n. oliva superior* was studied. The dynamics of size changes was traced for hair cells and brainstem nuclei to reveal the rapid growth until embryonic day 19 in chickens, hatching in herring gull, 17th posthaching day in owls and 7–8th posthatching day in pied flycatcher, i.e. rate of changes had decreased 1–3 days before the effective thermocontrol was established. Auditory neurons pass to the stage of early growth at the onset of hearing, to the stage of late growth – when the

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effective thermocontrol is established and to the stage of maturation – at fledging. Auditory system is involved into feeding behavior since the functional maturation of the earliest hair cells when auditory neurons pass from the stage of determinated neuroblasts to the stage of early growth. – Research was supported by the RFBR grant # 03–04–49072 and grant „Russian Universities – Fundamental Research".

P01-3 On the patterning of avian embryonic development

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Difference in the rate at which the post-embryonic growth proceeds has in a number of studies been largely attributed to changes in the relative growth of the various tissues and organs. It appears that individuals with higher than average growth rates (e.g. altricial avian species) are those that allocate a large share of their early growth into rapid early development of „supply" organs, such as the gastrointestinal tract and liver. Such a large early investment in these organs may have been at the expense of growth directed to „demand" organs such as muscle, feathers, and brain. These findings illustrate that competition among organs during development is part of the mechanism that regulates the relative size of various body parts. As a consequence, it would appear that such a mechanism also acts as a guiding signal for shaping patterns of development in the embryo. We test this prediction by comparing patterns of early embryonic development in birds that exhibit different patterns of post-natal growth. We used embryos of some precocial species and some altricial species with low and high growth rate, respectively. Our evidence suggests that a high rate of growth drives changes at early embryonic stages in patterns of brain and intestinal development, consequently affecting „supply"/„demand" organ relationships. These observations are in close agreement with the post-embryonic data and, moreover, conflict with the received wisdom that all vertebrate embryos share a common and highly conserved developmental program.

P01-4 Effect of season time, plasma testosterone level and body size on call rhythm of corncrake *Crex crex*

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During two breedings seasons (2001–02) corncrake *Crex crex* males were recorded in Kampinoski National Park (central Poland) in ten days intervals. Sound material collected consists of 507 recordings of totally over 56 000 calls. Several acoustic parameters were measured and 80 birds were caught for measurements of body size and plasma testosterone level. Temporal parameters characterising calls of corncrake *Crex crex* males were significantly affected by the time within breeding season, plasma testosterone level and body size. We found that the most striking variation of cracking-call production was related to between-calls intervals, which make call monotony or intermittent. in temporal pattern perceived as rhythm. Intermittent rhythm was more frequently used in the beginning of season and to some extent before the second breeding attempt. Males calling with such a pattern were characterized by higher testosterone level and larger body size. Simultaneously, intermittent rhythm was

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connected with less continuous and lower in rate calling, i.e. with presumably lower energy expenditures. We suggest that call rhythm is a conventional signal of aggressive motivation within a communication network consisting of several males signalling in semi-lek system. The longer duration of between-calls intervals in intermittent calling may be useful in simultaneous receiving signals from competitors and the possible cost of such aggressive calling may be rival retaliation.

P01-5 Factors influencing resting metabolic rate of pied flycatcher fledglings (*Ficedula hypoleuca* Pallas)

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The plumage of pied flycatcher (*Ficedula hypoleuca*) males varies from conspicuous to cryptic. Recently, the father's colour type was shown to be related with resting metabolic rate (RMR) of offspring (Kerimov, Ivankina, 1999). The RMR could be performed as BMR + PE, where BMR is basal metabolic rate and PE is productive energy. The question is: does colour type dependence of offspring's RMR relate to growth pattern or to BMR? To clarify the problem, we studied the growth rates of body mass, tarsus and wing in offspring of differently coloured males. The rates of oxygen consumption by 13–15–days old fledglings and their parents at nighttime were used as estimates of RMR and BMR, respectively. Such factors as parent's age, brood size, mortality rate in brood, habitat, date of reproduction were taken into account.

The results confirmed the existence of relation between fledgling's RMR and father's coloration ($n = 267$). This relation was very similar to the effect of coloration on BMR in adult males. Offspring of conspicuous and pale males differed in growth rate patterns, but this difference didn't explain colour type dependence of RMR. The male coloration and fledgling's growth rate influenced on RMR independently. Besides colour type mediated relation between energetics of parents and fledglings, we found positive straight correlation between BMR of males and RMR of their offspring ($R_S = 0{,}49$; $p < 0{,}001$; $n = 80$). The results suggest that colour type dependence of fledgling's RMR reflects the variation in their BMR.

P01-6 Feeding and defense behaviour in pied flycatcher nestlings (*Ficedula hypoleuca*) – a succession in development

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The development of the main behavioral patterns of early ontogeny of flycatcher nestlings was analyzed with special reference to the maturation of sensory systems involved into feeding and defense behavior. It was demonstrated that feeding behavior, originally based on auditory afferentation later changed to

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be triggered by newly-emerging vision. At the same time auditory system switched to appearing defense behavior. Defense behavior started, presumably, as a derivative of the 2nd phase of feeding reaction – i.e. the phase of comfort state following active begging and movements in the nest in response to each arrival of adult birds with food. Phenomenologically early defense behavior and comfort state concluding feeding behavior were quite similar. Also, at the first stage of its development defense response lacked typical postural and cardiographic components: the sound of the species-typical alarm call caused no significant heart rate changes. Later, on day 9–10 alarm call caused the heart rate to decrease significantly. And only before fledging defense response acquired the typical cardiac correlate – a statistically significant tachycardia. It has also been demonstrated that the development of defense behavior was based on the maturing capability of nestlings' auditory system to discriminate between alarm call and other acoustic signals. Supported by RFBR. Grant # 01–04–49133a.

P01-7 The relation between basal metabolic rate and reproductive performance in great tit, *Parus major*

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The role of winter basal metabolic rate (BMR) as individual predictor of future productive effort was tested on 21 Russian and 14 Dutch great tit pairs kept in the outdoor 2 x 2 x 2 m aviaries from February till July in Moscow region. The dates and intensity of various forms of social and sexual behaviour were recorded. The rates of oxygen consumption at night time by a bird placed in closed system were used as BMR estimates. After the period of stabilization of social interactions within pairs, the BMR of both males and females did not differ from that of free living birds. Russian and Dutch tits of the same sex did not differ in BMR. Among males, the BMR correlated with indexes of their reproductive behaviour including dates of singing and sexual displays and time of formation of tight pair bonds. At the same time, the winter BMR of males was not related to the probability of producing eggs by their mates in spring. On the contrary, winter BMR of females did not correlated with indexes of their social and sexual behavior, but tended to be positively related with probability of egg laying. The latter effect was significant when such factor as male plumage quality was taken in account. The results confirm our recent findings on free living tits (KERIMOV, IVANKINA, 2001) showing pronounced sex-dependent asymmetry of energetic and social adaptations in wintering great tits.

P01-8 Climate variations, energetics and ecology of altricial birds

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The basal metabolic rate (BMR) in birds is the fundamental scale of its energetic power and an indicator of the maximal level of the daily work output. High basal metabolism is linked with

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higher productivity and higher level of activity. The work and its result are correlated: individuals who spent more energy for breeding produce better offspring. The breeding success and survival level of avian offspring are correlated with basal metabolism and thermoconductivity. Altricial development – childhood period required for the establishment of homoiothermy and formation of the basal metabolism. Basal metabolism in altricial birds is changeable and increases along the northward axis. During cold years basal metabolism in altricial birds is higher on average than during warm years. Energetics is tightly correlated with ambient temperature; hence abrupt fluctuations of temperature regime during the reproductive period must cause the significant changes in the structure of populations. Under stable conditions energetically diversity of individuals causes the species formation. In heterogeneous environment energetically diversity of individuals in a population remains relatively constant: for some years the population accumulates genes frequencies related with advantages that individuals receive due to differences in BMR. These differences are manifested in higher-BMR individuals occupying better territories. Hence the population's productivity and breeding success increase. Abrupt yearly change of temperature regime favors individuals with opposite energetic characteristics, returning the genes frequencies in a population more or less to the initial level. Stability of population's structure is also supported by the fact that individuals originating from optimal locations and having high BMR compete only for territories in optimal locations practically never occupying suboptimal ones, leaving them for individuals with low BMR. This helps „weak" individuals to preserve themselves during considerable periods. Evolutionally it resulted in the fact that moderate latitudes are inhabited by many populations but fewer species, while in tropical regions there are more species but they are more constant. Polymorphism of any characteristic in tropical regions is less pronounced, e.g. wing length in tropical species has smaller dispersion than in species inhabiting moderate climatic zones. In tropical species, BMR variations are less marked than in species of moderate and higher latitudes. This results in more narrow ecological niches of tropical species as compared with inhabitants of higher and moderate latitudes. Was supported by the RFBR grant # 03–04–48974

P01-9 Respiratory water loss during flight

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Bird flight is costly: Metabolic rates can be as high as ten times BMR. However, during long flights not only energetic demands have to be met, water balance has to be maintained as well. Water losses by excretion or evaporation are balanced only by metabolic water production. Respiratory water loss is a major factor in this equation. Nevertheless, it has not been measured directly in a flying bird before. An increased lung ventilation due to energetic demands leads to a higher oxygen uptake, but also increases respiratory evaporation. By recording tracheal air flow and the temperature of exhaled air in a flying starling we can calculate the amount of water lost by respiration. Experimental flights in the wind tunnel differed in speed or in ambient temperature. We found that the tidal volume doubled during flight and that breathing frequency increased by the factor 3.5. Despite differences in flight speed, respiratory frequencies and mean tidal volumes do not differ between experimental flights. In contrast to this, ambient temperature has a big impact on both, ventilation and exhaled air temperature, and therefore is the main factor influencing respiratory water loss. Our measurements of respiratory frequency, tidal volume and

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exhaled air temperature enable us to determine respiratory water loss quantitatively for the first time.

P02: Section: Mobbing, Aggression and Defense

P02-1 Mobbing on the salt-marsh – interspecific aggression between barnacle goose, *Branta leucopsis*, and brent goose, *Branta bernicla bernicla*

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The barnacle goose, *Branta leucopsis*, and the dark-bellied brent goose, *Branta bernicla bernicla*, uses the salt-marshes of the Leybucht in Lower Saxony for passage and for overwintering. If there is enough food the two species will specialise on different zones of the salt-marsh. During recent years the area of pasture on the Leybucht salt-marshes has been continually reduced. Therefore the geese concentrate on the few remaining pasture salt-marshes. But because the number of geese has increased they cannot find enough food. However, is the increase of the barnacle goose winter population since the beginning of the 1980s and the decline of the brent goose caused by interspecific competition? The results of our study in 2000 can be interpreted in this sense. In fact the brent goose is the more aggressive species but the barnacle goose is more dominant. Furthermore, most of the brent geese transfer to the salt-marsh after the departure of the barnacle geese. Therefore we can assume that as a result of the increasing number of barnacle geese and due to the increased competition between this two species the brent geese population at the Leybucht decreases or is displaced. The analysis was carried out within the scope of the research project „Auswirkungen von Bewirtschaftungsänderungen auf die Habitatwahl, Raumnutzung und das Verhalten der Nonnengans und Ringelgans am Beispiel der Leybucht im Nationalpark Niedersächsisches Wattenmeer" of the university of Osnabrück, Germany, financed by the Niedersächsische Wattenmeerstiftung.

P02-2 Mobbing behaviour: reciprocity based cooperation in the breeding pied flycatcher, *Ficedula hypoleuca*

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Recent non-experimental evidence suggests that reciprocal altruism may be more common in nature than previously thought. We have obtained experimental evidence of mobbing behaviour as reciprocal altruism in the breeding pied flycatcher, *Ficedula hypoleuca*, a small migratory passerine bird. Flycatchers attended mobs initiated by their cooperating neighbours. However, they did not join in mobbing initiated by their non-cooperating neighbours. Our results suggest that the birds followed a strategy called ‚tit-for-tat'.

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P02-3 Interspecific aggression between the tree and the meadow pipit in sympatry and allopatry

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We studied ecology of the tree pipit (*Anthus trivialis*) and the meadow pipit (*Anthus pratensis*) at three localities in the Czech Republic in 1999 – 2001. Two localities were inhabited by one pipit species; both species lived in sympatry but occupied different habitats at the third locality. We were testing two hypotheses explaining the habitat separation: (1) species have different habitat preferences; (2) interspecific territoriality plays a major role. In 2000 we carried out playback experiments to test the second hypothesis. We placed the artificial dummy of each species, accompanied with the corresponding playback, into the territory of a singing male, and observed the level of response. Five levels of response were distinguished, from no reaction to physical attack on the dummy. We tested both conspecific and heterospecific playback in each territory. Tree pipits were generally more aggressive in intraspecific experiments; however, their reaction to heterospecific song was very weak (especially at the allopatric locality, where only one male out of 26 reacted at all). On the other hand, the strongest reaction in interspecific experiments was observed in the meadow pipit population at the allopatric locality. We suggest that higher aggressivity of meadow pipits can be caused by their low ability to distinguish between conspecific and heterospecific songs. Their reaction to tree pipit song in sympatry was significantly weaker, which might be explained by behavioural adaptation to heterospecific songs in closer contact with the other species.

P02-4 Intersexual differences in nest defence in the genus *Acrocephalus*

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Stuffed model of the hen harrier was presented at nests of the reed warbler (*Acrocephalus scirpaceus*), marsh warbler (*A. palustris*), sedge warbler (*A. schoenobaenus*) and aquatic warbler (*A. paludicola*). Nest defence behaviour of both sexes consisted primarily of alarm calls and flights, and of a song in some males. Only the reed warbler males engaged more often in nest defence than females did. In the sedge and marsh warbler the opposite was found, while the aquatic warbler males did not defend their nests at all. Likewise, the intersexual differences in the intensity of nest defence (measured by calling and flight rates) revealed that the relative engagement of males was higher in reed warblers than sedge, marsh and aquatic warblers. This suggests that the relative male engagement in nest defence correlates with their engagement in other forms of offspring care like incubation or feeding the young.

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P03: Section: From mating to fledging (breeding biology)

P03-1 Pairing for the first time: Causes and consequences of mate choice in recruiting common terns (*Sterna hirundo*)

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In long-lived birds the positive correlation of male and female age within pairs reflects a choice of mates of similar age. In seabirds, authors used data of subsequent seasons in the same analysis, whereby the tendency for assortative pairing by age is strengthened by long pair bond durations, which are typical for these monogamous species. Furthermore pair mates of same age are often handled as breeders with same experience, even if nothing is known about their former breeding history. By the same reason it was rarely distinguished between first time breeders and birds which have already bred and therefore are able to retain the pair bond of the previous year, an option not existing for recruits.

In our ongoing population study of a common tern colony at Wilhelmshaven (NW-Germany) we marked all fledged common terns with transponders allowing automatic identification of breeders and non-breeders for lifetime throughout each breeding season at their natal colony site. In this way we are able to identify the recruitment year and age of each individual, as well as age and status of their mates (likewise a recruit or an experienced breeder), as far as they also originate from the „Banter See" colony. We present pair bonds of more than 300 recruits and found differences in age of mates between male and female recruits: Age of male recruits correlated with the age of their mates. Whereas in female recruits we did not find this relation. Furthermore we focus on variation in reproductive performance between paired recruits (42%) in comparison with recruits mated with experienced breeders (15%, 43% of the recruits were mated with a tern of unknown origin). Recruit/recruit pairs laid significantly smaller clutches than pairs with one experienced bird, who also produced more fledglings. The earlier a recruit arrived at the colony site the greater was the chance to get an experienced mate. Male recruits paired with experienced females had a significant higher body mass at arrival compared to male recruits paired with female first time breeders or less experienced females. Our results suggest that „good partners" are available only for some first time breeders (in males probably the birds of high quality), and imply a fitness benefit: In the year of first breeding recruit-experienced breeder pairs had a higher reproductive success (Supported by the Deutsche Forschungsgemeinschaft; BE 916/5).

P03-2 A rare case of polygyny in Montagu's harrier in Poland

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Montagu's harrier *Circus pygargus* is generally a monogamous species. Since 1923 year in Great Britain described only 13 causes of polygyny (Cramp & Simmons 1980). Rare cases of polygyny was described by Arroyo (1995) in spanish population of Montagu's harrier. Similar situation described Pandolfi at al. (1995) in Italy. For 1990 to 1995 observed indyvidually marked population of Montagu's harrier on calcerous marshes near Chelm in eastern Poland. In the time of pre-laying period one of male displayed in two territories. This male had two females. Distance betwen nests was about 300 m.In the nest of first female was 3 fledglings. In the second nest only one.

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P03-3 Male paternal success in the promiscuous aquatic warbler

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The paternal success of 33 aquatic warbler males from a Polish population was determined by microsatellite PCR analysis. The number of sired nestling per individual male ranged from 1 to 8. Distribution of reproductive success between males was uneven with 6 males fathering 44% of nestlings in the study area. The number of nestlings sired by a male correlated positively with its fat deposits and wing length. Males with high reproductive success arrive earlier in spring on breeding grounds than males with low reproductive success. Males infected by blood parasites (trypanosomes) sired fewer offspring, weighed less and probably arrived later to breeding grounds than uninfected males. These finding indicate that male fitness directly influences paternal success.

P03–4 Searching for a mate: Colony attendance patterns of common terns (*Sterna hirundo*)

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We investigated the spatial movements of common terns at the breeding colony site during mate choice and courtship. It was supposed, that birds which retained their mates should concentrate their movements around their last year's nesting territory whereas birds which lost their mate should expand their search for a new partner throughout the whole colony site. The field work was carried out in 2002 at a colony site on artificial islands in the harbour area at Wilhelmshaven („Banter See"). In that year, about 300 common tern pairs were breeding there. All native breeders born since 1992 have been marked as chicks with passive transponders and are therefore well-known concerning their sex, age and life-history. Within the colony site, 44 preferred resting places were equipped with special antennas to record automatically the locations of the transponder-fitted birds. We documented the development of spatial attendance patterns from arrival in the colony to laying date depending on sex, age, pair bond and arrival date of mates. After arriving in the colony the females used more resting places than the males. This ratio shifted, however, in the last days before laying, when the females became more „homely" than the males. Recruits used more resting places during mate choice than experienced breeders, which showed a higher affinity to the area of their later nest-site. Although expected, birds which retained their mates showed no significant differences compared to birds which were divorced or widowed. But asynchronous arrival of mates influenced the spatial movements during mate choice. Couples with a long-lasting pair bond demonstrated a higher accordance concerning their use of resting places than newly paired couples (Supported by the Deutsche Forschungsgemeinschaft BE 916/5).

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P03-5 Territoriality and mate fidelity in great tits (*Parus major* L.) in Western Siberia, Russia.

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The study was conducted in Tomsk (1992–2001). The density of the great tit was 8.2–11.5 specimens/10 ha and 14.8–26.3 specimens/10 ha in a summer and a winter, correspondingly. We tagged 1179 birds by colour rings, 725 of them were subsequently recovered. In total we observed recovered birds by 3929 times.

In a winter 71.6 percent of the great tits inhabited 2.2–4.5 ha area, 16.2 percent of the birds used less than 2 ha areas, and 12.1 percent of the birds lived on larger than 20 ha areas. The breeding territories were settled within wintering areas in 91 percent of males and 75 percent of females among 93 over wintered and nested birds. The breeding territories were bordered about wintering one in 8 percent of males and 17 percent of females. The breeding and wintering territories were not bordered in 2.1 percent of males and in 7.1 percent of females. The breeding sites were not changed in 81.2 percent of males and 64.2 percent of females in 44 birds nesting during 2–6 yeas. The immigrants and settled birds did not differ in the level of the breeding site fidelity. Repeated clutches were initiated on the same territory (n = 11). Five couples were not broken during 2 seasons and two couples were preserved during 3 seasons. The great tits did not change their territories even one of mates died in a winter (n = 24). Evidently, the high fidelity to wintering and nesting territories provided sufficient level of comfort and survival of both adult birds and nestlings in taiga of Western Siberia. The studies were supported by the INTAS – 94–31–69 and grant „University of Russia“ No 015.07.01.15.

P03-6 Breeding dispersal in a homogeneous habitat: a study on great tits

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We studied breeding dispersal in a nestbox great tit *Parus major* population in a homogeneous habitat (orange monoculture) in eastern Spain. All the birds included were individually ringed, the position of their breeding nestbox noted using a GPS, and the distance moved between first breeding attempts of consecutive years (breeding dispersal distance) calculated from UTM coordinates. We used data from 401 different individuals, gathered between 1993 and 2000.

We found no significant relationship between breeding dispersal distance and tarsus length, weight, or condition index (weight/tarsus length ratio) in either sex. Most adults (EURING 6) bred in the same place in consecutive years (67% males, 63% females). We found no significant differences among juveniles (EURING 5). Among those individuals which did move, there were no significant differences between sexes or age classes in breeding dispersal distance. Females had significantly more chances of dispersing if they change mate between years (49% of females which changed pair moved, while only 28% of those keeping the same mate did). This trend was not found among males (39% and 28% respectively). Among individuals which did disperse, females which changed mate moved longer distances (123 m) that those keeping the same mate (103 m). Again, this trend was not found among males. These results confirm the lower mobility of adult birds, while those individuals breeding for the first time were likely to change the breeding place the next year. It is also shown that males tended to keep the breeding place (territory) either if they kept or if they changed mate, while females changing mate were more likely to move to another territory.

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P03-7 The breeding ecology of Kruper's nuthatch (*Sitta krueperi*) in Antalya, Turkey

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Sitta krueperi (Krüper's nuthatch) is an endemic bird mainly distributed in Anatolia. A few individuals present in Caucasus, and in some Greek islands. In this research breeding ecology of *Sitta krueperi* has been investigated in their nest boxes. Total of 250 wooden nest boxes were made and 200 of them were painted with orange, yellow, green and blue colours, each of which were applied to 50 boxes. The remaining 50 boxes were not painted. It has been found that the incubation period starts by early March and lasts until late June. 15 of 250 nest boxes have been occupied by *Sitta krueperi*. Fifty-seven per cent of the birds preferably used the unpainted, 21% yellow, 14% blue, and 7% orange nest boxes. Green nest boxes have not been used by any pair. The nest materials were composed of very thin bands of tree cortex (66.3%), pine seeds (21.3%), bristles (5.5%), feathers (2.8%), lichens (2.5%), and nylon and cotton threads (1.3%). Inside the nest boxes, eighty-three eggs were found, among which 84.3 per cent (70 eggs) has yielded offspring. Fifty-four chicks (65%) have succeeded to fly. The average number of juveniles which managed to fly was about 3.6 per pair. The most important factors against the success of incubation are the cutting of dry-old trees and occupation of nest boxes by *Dryomys nitedula*, bats, insects and bees. The food supplies for the chicks in their nests were found to be Coleoptera (33.3%), Lepidoptera (13.8%), ants (4.6%) and other Hymenoptera (1.2%), Homoptera (4.6%), Dermoptera (3.4%), Diptera (3.4%), Arachnida (3.3%) and unidentified small insect larvas (20.7%), worms (6.9%) and seeds (5.8%).

P03-8 Body mass of female great tits (*Parus major*) at egg laying

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Applying automated nest weighing, we determined the morning body mass of 22 female great tits over the egg-laying period between 1995 and 2002. Our data show that females maintain their body mass over egg laying (Repeated Measure ANOVA, time effect; $F = 1.267$, $p = 0.351$, $n = 13$). However, each female who had started incubation one or three days before the last egg was laid, lost body mass at starting incubation. The longer a female incubated on the last but one day the more mass she lost (Kendall's $C = 0.477$; $p = 0.042$; $n = 11$). In further analysis we estimated female morning weight from three randomly choosen day. We did not find any correlation between body mass and clutch size ($r = 0.05$, $p = 0.83$, $n = 22$), thus it is improbable that body mass at laying has a role in the proximate control of clutch size.

P03-9 Egg size variation along the laying sequence in great tits

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In birds, eggs dimensions frequently differ within a clutch. The pattern of intraclutch egg-size variation is not clear: some studies have found an increase in egg size along the laying sequence while others have found the opposite or no trend. We examined the intraclutch egg-size variation in a great

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tit *Parus major* population during 5 years, noting the position and mass of 844 eggs from 112 complete clutches through daily visits to the nestboxes. We found a common pattern of variation in all the clutch sizes examined (6 – 9 eggs): mean egg mass increased with the laying sequence until half of the eggs were laid, and then decreased until the final egg. Curvilinear regressions were fitted to data for each clutch size. Mean egg mass of the first egg was always smaller than the mean egg mass of the clutch. Along with the hatching asynchrony known to occur in the studied population, the smaller size of final eggs in all the clutch sizes examined supports the idea of a „brood reduction" strategy: reduced investment in final eggs/chicks, allowing their premature death in bad feeding conditions. On the other hand, the smaller size of first eggs (which has received much less attention to date) could be explained if females start laying when a threshold in resource availability is reached, and/or if the efficiency of female reproductive system is still low when laying begin.

P03-10 Stress protein response to infection by blood parasites in blue tits (*Parus caeruleus*)

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It is well established in model organisms under laboratory conditions that heat-shock proteins (HSPs) respond to a great variety of stressors, including parasites. However, field studies with wild animals are quite scarce. It has been suggested that blood parasites are a source of physiological stress for avian hosts, but until now, this hypothesis has been only approached in a few correlational studies. Here we report the first experimental evidence relating blood parasite infection and host stress response in a wild-bird species. We significantly reduced the intensity of infection by *Haemoproteus* sp. in one half of the breeding female blue tits (*Parus caeruleus*) through medication with an anti-malarial drug (primaquine). The other half of birds were injected with saline solution as controls and their intensity of infection was not reduced. Control females increase blood HSP60 levels whilst medicated females maintain similar levels across the experiment. Furthermore, birds changing status from uninfected to infected by *Trypanosoma avium* showed an increase of blood HSP60 levels. Therefore, presence and maintenance of blood parasite levels during reproduction produce an increase in HSP60 levels. The potential adaptative significance of this response may allow blue tits to maintain parasitism under control during breeding season.

P03-11 Causes of failure of the unhatched eggs of three species that breed in the orange groves of Eastern Spain

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Studies that deal with the breeding success of birds usually give information about the hatching success. Many of these studies have pointed out the predation or desertion percentages, but other causes involved in the failure of hatching have not been so well documented. We studied the causes of hatching failure in three common species of the orange groves of Valencia: two open-nesters, the

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blackbird *Turdus merula*, and the serin *Serinus serinus*, and a hole-nester, the great tit *Parus major*. Only those eggs that were found in nests where at least one egg hatched were considered.

Hatching success in the blackbird (93.1 %) and the serin (92.3 %) was higher than in the great tit (84.5 %). We classified hatching failure in 2 types (1) infertile eggs (eggs without embryos) , and (2) fertile eggs whose embryos died during development or, if wholly developed, they failed just in hatching. Our results point out that in open-nesters, infertility (blackbird = 50.0 %; serin = 54.8 %) is similar to failure of embryo (blackbird = 50.0 %; serin = 45.2 %), contrasting with the hole nester, the great tit, whose eggs failed during the development of the embryo (70.7 %), rather than in fertilisation (29.3 %).

P03-12 Egg rejection responses in two rare common cuckoo *Cuculus canorus* hosts

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In a coevolutionary arms race between a brood parasite and its host, both species are expected to evolve adaptations and counteradaptations, such as egg mimicry and egg recognition. We studied egg discrimination in two poorly known cuckoo hosts (whitethroat *Sylvia communis* and yellowhammer *Emberiza citrinella*) in southwestern Moravia, Czech Republic, in an area where the two species have been parasitised only occasionally. To investigate responses to parasitic eggs, either a non-mimetic or a mimetic (conspecific) egg was added to the host clutch in the late egg-laying period or during incubation. Non-mimetic eggs were rejected at a higher rate than the mimetic eggs in both species: 100% (n = 21) and 54% (n = 13) in the whitethroat, and 92% (n = 13) and 32% (n = 37) in the yellowhammer. Intraclutch variation in egg appearance had no significant effect on rejection responses in either species. Ejected mimetic eggs in the whitethroat, however, showed higher contrast with host eggs than did the mimetic eggs that were accepted. Our experiments show that both whitethroats and yellowhammers are firm rejecters of alien eggs unlike their own and that the species are also able to discriminate against mimetic eggs. These facts are discussed in the light of the host selection and host-parasite coevolution hypotheses.

P03-13 Body-mass loss is a cost of parental care

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Body mass of a female great tit changes over day and night by 5%, before egg laying and after hatching by 10%. Loss of body mass in the breeding season is considered either as a cost of reproduction („stress hypothesis") or as an individual trait optimised in relation to the activity of the bird („adaptive mass loss hypothesis"). In 1999 and 2000 we run three field experiments to study the reactions of great tits to changes in their environments. Each nest included in the experiments was monitored by automated weighing. These experiments confirmed that harsher conditions decrease female body mass to the benefit of parental activity. In E1 we studied the effect of decreased morn-

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ing temperature in the incubation period, in E2 we cooled nest-boxes each morning for a week after hatching, in E3 we tried to mimic nest-disturbance by a dangerous and stubborn nest-predator of great tits, the great-spotted woodpecker, *Dendrocopus major* in the peak feeding period. Cooling in both experiments and the presence of nest-predator decreased female body mass due to changed activity. In the incubation period cooling increased on-bout duration and attentiveness in turn it increased mass loss over on-bouts and decreased the average arrival mass of the females during the treatment period. While repeated cooling each morning did not influence the body mass of 7 days old nestlings, their mothers shortened the length but increased the number of their brooding visits, decreased the length of foraging bouts and lost higher amount of body mass over the first week after hatching. Females had lower body mass and increased provisioning rate not only in the treatment period (1 hour) but also several hours after the treatment. These results may be interpreted in an individual optimisation framework. However, optimisation of body mass does not exclude that repeated, increased mass loss may have a fitness cost, through e.g. decreased immuncompetence. The majority of the statistical analysis was based on repeated measures generalised linear models. Differences given in the abstract are all statistically significant at the $p = 0.05$ significance level.

P03-14 Does hoarding affect the chicks' condition in urban kestrels?

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In kestrels *Falco tinnunculus* inhabiting open landscape, whole or partly eaten prey is often cached (hiding) by hunting birds or by incubating females – in most cases on the ground. One obvious function of caching is to store prey that has been caught more frequently than is needed to satisfy hunger; due to caching, kestrels may also continue hunting during times of increased food availability as well as be ensure that food is available for an evening meal. For experiment 12 kestrels' nests situated in various part of the city were chosen. Among them 4 were supplemented with food (F) and 8 were used as controls (NF). Chicks were weighted daily to the nearest 1 g. At day 11 of the oldest chicks' lives the tarsus length was also measured to the nearest 0.1 mm. Dead dark-coloured mice – one per chick per day were provided to the F-nests. Chicks supplemented with food and those unfed slight differed in body mass but all differences were statistically insignificant. It can be stated that body mass of F chicks were slighty higher than in NF only when the mean mass of all nestlings present in the nest was analyzed (in average 125.6 g vs 118.3 g). In the group of oldest 11-day-old nestlings the opposite phenomenon was observed (in average 137.2 g vs 142.3 g). Above data suggest that in F nest younger chicks could successfully compete for food with older siblings – they grew faster and reached higher body mass in comparison to the NF chicks. So food hoarding (imitated by surplus food) could affect the younger chicks growth and their survival. In any of nests from F group the number of chicks changed. But in 50% of NF nests the breeding loses occurred.

P03-15 Male bill colour and parental care in the blackbird *Turdus merula*

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In many monogamous bird species, male parental care is crucial for the survival of young, and thus, females may obtain benefits by mating with males providing a high paternal care. However,

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mate choice precedes paternal investments and female can't directly assess this direct benefit during pair formation. Carotenoid-based colours may honestly signal paternal quality because they may reflect individual foraging abilities. The blackbird *Turdus merula*, a socially monogamous species, exhibits biparental care and males show yellow to orange bills coloured by carotenoids. We hypothesized that male bill colour signal their individual quality and have studied the relations between this trait and parental care. Our results suggest that males with oranger bill are better fathers. In addition, these males showed also higher levels of prolactin, an hormone that promote parental behaviour. We discussed our results in relation to sexual selection process.

P03-16 Parental investment in Wilson's storm petrel

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Extensive studies have been carried out in a breeding colony of Wilson' storm petrels (*Oceanites oceanicus*) on King George Island (South Shetlands, Antarctica) since 1996. This work aimed to investigate sex-specific parental investment in two austral summers (2000/01 and 2001/02). Previous research had shown clear deviations from the hypothesis of BECK and BROWN (1972), which proposes a higher nest attendance of males but a higher food delivery of the females. Data from 1996–2002 did not indicate a higher nest attendance of males. Chick feeding, which takes place predominantly at night, was investigated in detail in two seasons using an infrared camera installed in the nesting burrow. Pair members were marked individually allowing sex-specific statements. Weighting of chicks was done at dawn and dust to enable us to calculate the amount of food received.

P03-17 Allocation of parental investment in the south polar skua (*Catharacta maccormicki*)

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A reproducing bird is strongly constrained by time and energy. It can reflect its resources to very different activities, which are usually mutually exclusive. This study was conducted to investigate the allocation of parental investment in the south polar skua (*Catharacta maccormicki*) using data on nest attendance, adult mass loss and chick growth. An experimental approach was chosen by offering about 10 % of the chicks daily energy demand to half of the breeding pairs.

Breeding pairs had a very high nest attendance and nearly never left alone their offspring. Adult females did not change their attendance pattern in response to the treatment but males of food supplemented pairs were more often in the territory than males of control pairs. Mass loss of adults was positively correlated with number of fledglings and chick growth. A treatment effect

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could only be observed in females. Food supplemented females lost more mass than females of control pairs. Provision of food had only minimal effects on overall chick growth performance. Male chicks, which hatched second, had higher growth constants for tarsus growth if their parents got extra food. Furthermore, chicks of food supplemented pairs had a mass growth advantage over control chicks during bad weather conditions. The breeding season 2000/01 was extremely good and the results of this study are most likely not universal. Chick growth was nearly not limited by the food supply through the adults in this season. Adult skuas invested surplus time, gained by getting food from the experimenter, in nest attendance. The study was funded by a grant from the DFG (Pe 454/11–1).

P03-18 Mortality of skua and Wilson's storm petrel chicks in the Antarctic

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In the summer seasons 2001/02 and 2002/03 on Fildes Peninsula and Potter Peninsula (King George Island, South Shetland Islands, Antarctica) we investigated the chick mortality of south polar skuas (*Catharacta maccormicki*), brown skuas (*C. antarctica lonnbergi*) und Wilson's storm petrel (*Oceanites oceanicus*). The high hatching success and normal growth for skuas in the first weeks after hatching during favourable weather conditions suggested a productive season 2001/02 . However, from the end of January 2002 onwards very high chick mortality of all species was observed. The reasons for this could be a lack of food, or disease. The first of these is supported by evidence of very low krill-density (*Euphausia superba*) in the area at this time. Krill (and fish) are the main food for Wilson's storm petrel and south polar skua. The high mortality of brown skua chicks however suggests the disease hypothesis since brown skuas feed mostly on penguins or station garbage and would not directly be affected by scarcities in krill. In 2002/2003 we observed total breeding failure in south polar skua and Wilson's storm petrel and a high mortality of brown skua chicks. The analysis of krill and fish distribution data compared with the sea-ice distribution and actual weather conditions will show us the reasons for the high mortality in these three species.

P03-19 Does the number of breeding pairs depend on the fledgling production?: study of an increasing goldfinch population in the orange groves

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This study presents the trend of a population of goldfinches (*Carduelis carduelis*) that breeds in a plot of 16.92 ha during 28 years (1975–2002) in Eastern Spain. Each year we determined the num-

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ber of breeding pairs in the plot by means of exhaustive nest searching and the mapping method. Nests were also monitored, so we know the number of fledglings per breeding season in the plot. Correlations between some reproductive variables (number of pairs, number of nests, number of clutches per pair, number of fledglings, number of fledglings per pair and number of fledglings per nest) were performed. We also tested if the yearly number of breeding pairs depended on the results of previous years. Our results showed a strong population increase from 0 pairs in 1975 to more than fifteen pairs in the last five years (regression model: Number of pairs = 0.637 * year – 1259.5; $R^2 = 0.8278$; F = 124.95; d. f. = 26; $p < 0.001$). Obviously, the number of pairs was strongly correlated with the number of nests and the number of fledglings in the plot. The number of clutches per pair was correlated with the number of pairs following a quadratic model (Clutches per pair = 1.4721 + 0.1564* Pairs – 0.0061 * $Pairs^2$; $R^2 = 0.411$; F = 6.28; d.f. = 18; p = 0.009). Multiple stepwise regression showed that the yearly number of breeding pair depended on the pair number in the previous year rather than the fledgling production.

P03-20 Survival of skylark (*Alauda arvensis*) chicks until fledging

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Skylark nests are usually regarded as successful when the young leave their nest although they are still flightless for ca 10 days and might fall victim to predation or farming activities (e.g. mowing). Information about survival rates during that critical period is scarce. Therefore we used radio-tracking to study behaviour and survival of skylark chicks hatched in ecologically managed farmland in the biosphere reserve „Schorfheide-Chorin" (60 km north-east of Berlin). Our results show that losses due to predation during the pre-fledging period can be very important at least in some years. The study was supported by the Federal Agency for Nature Conservation (BfN) as a part of the „Nature Conservation Farm Brodowin" project.

P03-21 Breeding ecology of the bittern (*Botaurus stellaris*) in fishpond areas in SE Germany

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The study was made in an area of 280 km? in Upper Lusatica/Saxony, where fishponds form a suitable breeding habitat for bitterns. From 1999 to 2003 up to 25 booming males were registred each year in the study area (= 8,9 males per 100 km^2). Most of the booming sites were located in reedbeds of more than one hectare size. Some males are polygynous; e.g. we found five breeding females in a fishpond area (110 ha) inhabited by two males. Nests (n = 47) were found in stands of *Phragmites australis* (47%), *Typha angustifolia* (32%), *Phragmites/Typha* (9%) and *Phragmites/Carex* (2%). Nest sites can be located some hundert meters away from the nearest regular booming site. A consequence for the conservation of the species in fishpond areas is to protect and restore either one big patch or a network of some smaller patches of reed suitable as booming, breeding and foraging sites.

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P03-22 Long term study in antarctic skuas on Potter Peninsula, King George Island, Antarctica

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In the period from 1993 to 2003 we investigated the populations of the south polar skua *Catharacta maccormicki* and the brown skua *Catharacta lonnbergi* at Potter Peninsula, King George Island, Antarctica. In the Poster we present our results on the population development, breeding success and breeding phenology of both species. The reasons for the yearly differences are discussed. Most of the birds were marked individually and we are able to describe constancy of breeding partner and nesting place. Moreover we give an overview of the migration patterns of skuas ringed as fledglings. The project was supported by the Deutsche Forschungsgesellschaft (PE 454/11).

P03-23 Birds and rodents destroy different nests: a study of blackcap (*Sylvia atricapilla*) using removal of nest concealment

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Nest-site selection strategies minimizing nest predation should be favored by natural selection. One obvious possibility is to select nest sites with more concealment that inhibits transmission of cues to predators. However, besides studies showing a positive effect of nest concealment on nest survival, there are numerous studies failing to reveal similar effects. Different nest predators may depredate nests with different nest-cover characteristics and composition of local predator fauna may determine net selection on nest concealment. In a two year study (2000 – 2001), I studied predation on natural blackcap (*Sylvia atricapilla*) nests baited with plasticine clutches to enable predator determination. To decouple potential correlation between concealment and other nest-site vegetation characteristics and/or parental quality, I experimentally manipulated nest concealment and followed effects of this manipulation on nest survival. Bird predators depredated mainly nests with poor concealment and those relatively high in vegetation, whereas rodent predators depredated mainly low-placed nests. However, when both predator types taken together, there was no net selection on nest height, whereas positive selection on concealment remained. This indicates that different nest predators may select for different nest-site characteristics in accord with their activity patterns and the way they locate food. Consequently, composition of local predator faunas, which may change both spatially and temporally, may drive selection patterns on nest-site characteristics. This effect could lead to spatially and/or temporarily changing optimum nest-site characteristics, and explain varied results obtained on effects of nest concealment on nest survival by different investigators.

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P03-24 Application of data loggers to the study of temporal patterns of nest predation in passerines

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Most nesting studies conducted to date were based on repeated visits to the nest and recording of nest status (alive, predated, ...) on each visit. The exact timing of predation events thus remained unknown and had to be estimated as e.g. midpoint of the inter-visit interval. Increasing the frequency of observer visits to the nests is often technically impossible, because of time constraints, and/or unacceptable, because of increased disturbance to birds. In any case, even the frequent nest visits do not permit to study diurnal pattern of nest predation. I evaluated applicability of temperature data loggers to measure survival time of natural nests in open-nesting passerines (mostly *Sylvia atricapilla*, *Turdus merula*, *T. philomelos*, *Emberiza citrinella*). I obtained ca. 280 records, that can be interpreted as nest predation. Reliability of data logger recordings was validated by simultaneous monitoring of some nests by time-lapse video. The main preliminary conclusions are, that nest predation events were: (1) about equally frequent over the whole day and night; (2) not correlated with the timing of observer visits to the nest. Detailed analysis will be done after the 2003 field season.

P04: Section: Birds in patchy habitats

P04-1 Distribution of reed birds in farmland patchy habitats: effect of surrounding matrix

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Influence of land use on territory distribution of three reed passerines; sedge warbler, marsh warbler and reed warbler was examined in western Poland during years 1998–2000. At the same time, use of crops as a foraging and singing sites was investigated. During three years following numbers of breeding territories of sedge warbler, marsh warbler and reed warbler were found: 95, 171 and 249 respectively. All territories were located in 75 small (0.1 – 9.8 ha) marsh patches and ditches scattered over 890 ha of intensively cultivated fields. Eleven habitat parameters were measured in a area of 50 meters from the center of territory. Percentage of seven marsh habitats and length of four types of field-marsh ecotones: oil seed rape – marsh, spring cereals – marsh, winter cereals –mars and root crops – marsh were included into logistic regression model. Oil seed rape occurred near territories of sedge and marsh warbler more frequently than expected by their availability. The opposite influence of root crops was found in reed warbler. Moreover, all species tended to occupy particular patch in years with high ratio oil seed rape and low ratio of and root crops in surrounding fields. Birds foraged on three types of crops with unequal intensity which was the highest on oil seed rape and the lowest on spring cereals. Males preferred oil seed rape as a song post in relation to crop availability. Results obtained suggest that land use may have a strong impact on breeding territories distribution of farmland patch-nesting species. The relationship may be connected with a quality of foraging ground located on crops and similarity of their structure to marsh vegetation as well.

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P04-2 Demographic responses by birds to forest fragmentation

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Destruction of natural habitats involves two different, generally simultaneous changes in the landscape, habitat loss and habitat fragmentation. Fragmentation effects can compound the negative effects of habitat loss on bird populations. We studied effects of fragmentation on demographic patterns of forest birds. Our data consisted on 41 published studies and 164 species effects (species x demographic variable). Meta-analysis was used to determine differences between groups. For various reasons, it was not possible to include all available studies into meta-analysis, and that is why more traditional „vote-counting" method was also used to confirm the results.

Because of publication bias and non-random selection of species and landscapes, results of this analysis should be interpreted with caution. However, results showed that cavity nesting birds, as expected, were less sensitive to fragmentation than tree- or ground nesting species. There was no difference between migrants and residents or between the Nearctic and the Western Palearctic regions. However, there seems to be significant interaction between these two variable groups: Nearctic migrants seem to be more sensitive to fragmentation than Palearctic migrants, but between residents there is no such difference. Results also tell that how research interests have differed regionally. For example, researchers in the Nearctic have generally been more interested in migrants where as in Palearctic there has been more interest on residents. Furthermore, far too little or no studies at all are available from any other region to make general conclusions about the fragmentation effects on bird populations.

P04-3 Forest fragmentation affects breeding biology of the great spotted woodpecker *Picoides major*

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Process of forest fragmentation influences various aspects of avian biology from the community composition to biology of particular species. Sedentary forest birds like woodpeckers could be especially vulnerable to decreasing of forest areas and increasing isolation between them. Therefore the aim of the study was to describe population's features of great spotted woodpecker in fragmented landscapes. The study is carried out in a plot ca 145 km^2 (Central Poland). The amount of forestation in this area is very low (ca 6%) and those forests that do exist (ca 40 woodlots) are heavily fragmented, and differ in size (1–200 ha). During studies woodpeckers are observed, caught, colourly ringed, nest are searched and controlled. It was found that great spotted woodpeckers occasionally can breed in very small woodlots, but in forest patches greater than 10 ha at least 1 par breed every season. Densities of breeding pair were not related to the size of the woodlots. In relatively large forests (>120 ha) woodpeckers excavated their holes in several tree species. The holes in aspen *Populus tremula* were not so frequently (38%) as it was in smaller woodlots (64%). Also it seems that in small forest woodpeckers breed lower than in larger ones. Woodpeckers fledging period differ in relation to forest size, and more late broods occur in small forests. Also the number of

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fledging seems to be smaller in smaller woodlots. Ca 70 individuals was caught, but no local movements were observed. The study was supported by Polish Commitee for Scientific Research (KBN) grant no 6P04F 06920.

P04-4 Blood parameters in great tits breeding in different habitats

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Many forest passerines are known to prefer deciduous woodland as nesting habitat. Unfortunately, preferred habitat nowadays mainly exists as isolated patches between cultivated lands. Providing nest-boxes in non-preferred but widely available habitats (e.g., managed pine forests) allows for certain species to breed also in these habitats. A long-term study revealed that great tits in our study area prefer deciduous woodland patches and lay larger clutches there than in the pine forest. As expected, also caterpillars are more abundant in the deciduous woodland than in the pine forest. However, the final reproductive output of tits (fledgling number and mass) is higher in the pine forest than in the deciduous forest. In order to determine the possible proximate mechanism underlaying such an unexpected difference between the habitats, several blood parameters of parents (white blood cell counts, hematocrit and plasma proteins) were measured to assess their health condition. Males were in a superior health condition in the pine forest than in the preferred deciduous woodland. In females, none of the studied blood parameters differed significantly between habitats, although they weighed more in the deciduous woodland than in the pine forest. We suggest that an inferior health condition of males, caused by high rate of intraspecific interference, may be the reason for a relatively low fledging success in the densely populated deciduous habitat fragments.

P04-5 Lifetime reproductive success of Tengmalm's owl males in a habitat mosaic with temporally fluctuating food abundance

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Tengmalm's owl (*Aegolius funereus*) is a bird of prey that lives in boreal coniferous forests and subsists on small mammals, which show 3–5-year cyclic population fluctuations in Eurasian boreal areas. Landscape composition of the territory affects the breeding success of Tengmalm's owls depending on the year. For example, in years of decreasing vole abundance, nestling survival and fledgling production decline steeply with increasing proportion of farmland in the territory. This could be due to predators and their exploitation on small mammals beginning from farmland areas and spilling over from farmland habitats to barren forest habitats. Here we analyse the effects of habitat composition on the lifetime fledgling production of site-tenacious Tengmalm's owl males. We also examine whether male owls change breeding site within their territory annually according to habitat differences in small mammal abundance. Finally, we analyse whether previously detected age-differences in reproductive success of the owls might be explained through non-random spatial distribution of different-aged owls.

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P05: Section: Migration

P05-1 Variation of stopover duration of reed warblers in Morocco: effects of season, age and site

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Stopover duration and rate of body mass gain during stopover were investigated for the reed warbler *Acrocephalus scirpaceus* stopping over at two sites in Morocco, Sidi Bou Ghaba on the Atlantic coast, and Kerbacha on the Mediterranean coast. Estimation of stopover duration was done using the recent method by SCHAUB et al. (2001). We investigated effects of age and site on stopover parameters during autumn and spring migration. Stopover duration was longer for juveniles than adults, longer at the Atlantic site than at the Mediterranean site, and longer in autumn than in spring. Altogether, estimated stopover duration was longer than expected from previous studies based on minimum stopover duration. Body mass gain varied inconsistently among site, season and age classes, without clear relation with stopover duration. This suggests that stopover duration is not only dependent on the rate of body mass gain.

P05-2 Unsolved questions of migration strategies in a passerine bird

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Testing general optimality models in bird migration one is still faced with some unsolved and often species-specific questions. Dealing with long distance migrating passerines we are still lacking information about the performance of migration: In how many steps is the migration carried out? How many suitable stopover sites can a bird expect along its route? How fast do they deposit fat for the next flight? Even if we consider that saving time or energy might be selective forces acting on bird migration, the consequences are sometimes still difficult to predict. Beside habitat quality, stopover decisions might also depend on already covered distances as well as on the expected migration route. Observations on migrating wheatears (*Oenanthe oenanthe*) on the German island Helgoland in spring proved that birds breeding in Iceland, Greenland and east Canada show different stopover strategies compared to continental breeding birds. By analysing ringing data and observations from different stopover sites throughout Europe, the hypothesis is tested that the continental subspecies opposite to the Greenlandic birds avoids large fuel stores and migrates in many small steps over land. In contrast, Greenlandic birds approaching the western European coast on spring migration have to store large amounts of fat for the barrier crossing and therefore rest longer on profitable stopover sites. Such flexible migration strategies within this species were essential to settle remote breeding areas like Iceland, Greenland and even Canada.

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P05-3 Autumn migration dynamics of goldcrest (*Regulus regulus*) in Western Hungary

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In autumn migration season of the 2498 goldcrests ringed 124 were captured in 1998, 112 in 1999, 521 in 2000, 451 in 2001, 42 in 2002 at Tömörd Bird Ringing Station (47.22° N, 16.41° E) in Western Hungary. Sex ratio, daily capture, the proportion of recaptured birds, the wing-length, tail-length and the amount of reserved body fat of migrants were examined. The northern populations arrived at the end of September and their migration passed to early November, the passage peak was late October at Tömörd. Only one bird, ringed in Russia (Rybachy) was recaptured at Tömörd. The migration usually was very rapid, the 5 % of the birds ringed were recaptured in the period of the ringing and their stopover time was only 1–2 days in 2000 and 2001. The birds captured in the peak period had enough fat store for migration, the average fat index was 3.91 ± 0.98 (n = 383) for males and 3.68 ± 0.88 (n = 173) for females in 2000. There were not significant differences in daily capture between the males and females (r > 0.9), they migrated together. On the basis of the comparison of wing-length, tail-length and body mass between the birds captured in different migration periods, we find some significant differences. The proportion of migratory males (63.07 %) was higher than females' (36.93 %). Our orientation results and one bird recaptured in Italy (near Bologna) showed that the migratory goldcrests preferred the SW and SE direction from Tömörd.

P05-4 Migrations of yellow-legged gull *Larus cachinnans* ringed in the middle Dniepr area, Ukraine

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Yellow-legged gulls have expanded up-stream of the Dnieper after the creation of reservoirs. The colony near the Kaniv hydroelectric power station has arisen in 1991. Last years its number fluctuates about 300 breeding pairs. We started ringing on the colony in 1997. During 6 years 1715 chicks were ringed. 100 recoveries (including sight records) were received (5.8%). The majority of recoveries are originated from Poland (43%), Germany (27%) and the Netherlands (12%). One of our birds was tagged in Germany by A. Buchheim in December of 1999 (white 2H) and gave 13 recoveries from the Netherlands to France and Great Britain during 2000–2002. The extreme records of gulls ringed in Kaniv: to the South – Czech Republick (Ostrava) and South Germany (Bodensee); to the West – France and South England (area of the English Channel); to the North – Denmark, South Finland (Tampere) and Estonia. The majority of birds was found in a relatively narrow strip in the latitude of 51–55 degrees. First yellow-legged gulls from Kaniv are observed in Poland and Germany already since middle of July (the earliest date is 12.07.2002, Mecklenburg-Vorpommern, 48 days after ringing). Two recoveries from South Belarus allows to suppose, that gulls after breeding season fly up-stream of the Dnieper and migrate on valley of the Pripiat river to North Poland.

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P05-5 General features of chaffinch (*Fringilla coelebs*) ringed at the Courish Spit of the Baltic Sea seasonal distribution according to recovery data

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About 1800 ringing recoveries of chaffinches ringed at Rybachy station 1957–1995 were used. The comparison of samples was done with Mardia-test, in some cases regression and correlation analysis was applied. A map series for various groups' distribution is presented. During the nonbreeding period the local chaffinches were found significantly south of those ringed on migration. An assumption was made that most of passage birds originate from the Finnish populations. Monthly distribution was discussed and thus the mean limits of seasons for passage populations were determined (breeding and post-breeding from 01.05 till 31.08, migrations – 01.09 – 15.11 and 16.02 – 30.04, wintering – 16.11 – 15.02). Further the differences in distribution of sex and age samples, individuals ringed at different stages of autumn passage and on spring versus autumn passages were discussed for these seasons separately. In winter and on migrations males were recovered significantly north of females and immatures north of adults. chaffinches migrating later in autumn distribute in Europe north of the earlier ones. The breeding origin is among the significant factors of the passage date: chaffinches from the N Finland tend to fly over the Courish Spit later than their southern conspesifics. Chaffinches ringed on autumn passage distribute north of spring migrants. An attempt was done to account this for different migration routes of birds from different parts of Finland: Chaffinches from the SE part choose the route over the Courish Spit equally often in spring and in autumn while for chaffinches from the NW there are some facts indicating loop migration. These birds fly across the E Baltic coast in autumn more readily while in spring sometime choose the route over Denmark and Sweden.

P05-6 Changes and stability in timing of autumn passage in 19 passerine species in a stopover site in Southwestern Germany

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One of the possible reactions of birds to climate change is the change of migration timing. Results about changes in passage times of migrants were published for several bird ringing stations with standardised annual activity, for example by ENQUIST & PETTERSSON 1986 (Ottenby, Sweden), HÜPPOP & HÜPPOP 2002 (Heligoland), BERGMANN 1998 (Mettnau, Southern Germany), SOKOLOV et al. 2001 (Courish Spit, Southern Baltic). While generally spring passage timing tends to be earlier in recent years autumn passage times of different species are either unchanged, delayed or prematured.

On the base of the complete dataset of standardized autumn mistnetting at „Mettnau" study site in Southwestern Germany 1972 – 2002 migration periods (in contrast to other post-breeding movements) were defined for each species using the pattern of first captures per pentade. In all species this period is marked by a distinct increase and peak in trapping numbers. Since birds with heavy moult are not very likely to be on migration they were excluded at all times. For each species and year the day was calculated when 5%, 20%, 50%, 80% and 95% of the birds of each year were trapped. Linear regressions for the different percentiles where calculated and BONFERRONI-corrected. Five of 19 tested species showed significant delays in passage times since 1972 (*Acrocephalus schoenobaenus, Phylloscopus trochilus, Sylvia curruca, Turdus merula, T. philomelos*) and only the garden warbler *Sylvia*

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borin showed significantly earlier passage percentiles. Although both patterns can be explained in the light of global warming (warmer autumns may enable birds to stay longer, warmer springs may enable birds to breed earlier and to leave earlier as well) the direct correlation between annual passage time and annual summer mean temperatures is far less clear than in studies using spring passage data.

P06: Section: Winter Ecology

P06-1 Density and behavior of mistle thrush wintering in the Niepołomice Forest (southern Poland)

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Density and behavior of the mistle thrush (*Turdus viscivorus*) occurring in Niepołomice Forest (southern Poland) and adjacent open areas have been studied during winters of 1996/1997, 1998/1999 and 2000/2001 (December – February). Mistle thrush densities differed significantly between winters. Birds and mistletoe clump density indices were positively correlated. Birds held territories or grouped in flocks. In the forest, flocks were observed only during the winter 1996/1997 when the largest density of birds was noted. Flock size decreased throughout winter, but simultaneously the number of solitary birds was stable. We suggest that some birds from flocks started to hold territories. Bird flocks were observed also in open areas and they preferred to feed in pastures. In the forest, individual birds held the territories consisted of several clumps of mistletoe on few trees standing close together. Birds defended mistletoe clumps against conspecifics and also other species. Aggressive encounter rate was positively correlated with bird density and negatively with winter progression, but surprisingly was not correlated with mistletoe clump density and temperature. We suggest that during years with high berry supply, the density of bird may be so large, that defending fruits against many neighbours may be too costly and less profitable than feeding in flocks. We present a conceptual model explaining the observed phenomena.

P06-2 Willow tits (*Parus montanus*) in North Finland: habitat loss increases territory size

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We studied how wintering willow tits responded to habitat loss and fragmentation in a mosaic forest landscape in northern Finland. We examined habitat preference, flock and home range size of altogether 16 flocks, half of which had their territories in forests fragmented by forestry and half in continuous forest. Our hypothesis was that the birds would respond to habitat loss by enlarging their home range and/or reducing group size. In addition, to compensate for fragmentation effects, willow tits might be expected to include more optimal habitat into their territories. Flocks included on aver-

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age four birds and occupied territories of average 12.6 ha. The birds responded to habitat loss by enlarging their home ranges but not by diminishing the group size. The tits avoided anthropogenic open areas and preferred mature forests and older sapling stands or pine bogs equally. Large territories included a smaller proportion of mature forests. The birds on territories that included a large proportion of man-made open habitat localized their activity but over a wider area. We infer that willow tits adjust territory use to compensate for the inclusion of unsuitable habitat. However, the birds did not enlarge the proportion of mature forests in their territories with increasing habitat loss. Thus, our data do not imply a strong effect of fragmentation, but suggest that forestry practices reduce the suitable wintering habitat and carrying capacity in the area. Therefore, winter habitat loss may be the explanation for the observed population decline of willow tits in Finland during recent decades.

P06-3 Strategies of over-wintering in the Eurasian woodcock *Scolopax rusticola*

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To survive in winter, each bird has to resolve an adaptive trade-off between the need to feed and the avoidance of predation. In the woodcock, this trade-off is expressed at the level of habitat selection. The monitoring of radio-tagged birds indicated two strategies of over-wintering. Most of the woodcocks were active during the day (in forest) and at night (in meadows), but some of them were completely diurnal and stayed in the forest at night. An estimation of daily energetic expenditure did not show a difference of cost between both strategies. The risk of predation was higher in meadows than in the forest. The biomass of food (earthworms) was ten times higher in meadows than in the forest. The biomass of earthworms in the diurnal sites of the birds who usually stayed in the forest at night was higher than in the sites used by the birds who go to meadows. The decision to go to meadows at night seemed to be taken every evening, according to the success of foraging during the day in the forest. In case of successful feeding day, in a good patch of food, the bird was not obliged to take the risk to go to meadows. When the patch started to be depleted, then the bird could not achieve all its needs and was obliged go to meadows at night (where there was always enough food) and/or change of diurnal site. Therefore, the trade-off between feeding and predation risk depends on the efficiency of the bird to find a good patch of food in the forest and to exploit it optimally during the day.

P06-4 On winter foraging of the common eiders (*Somateria mollissima*) in the Kandalaksha Bay

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The number of common eiders wintering on the polynia in the Kandalaksha Bay, the White Sea (66°33′ N, 33°07′ E) in March 2001 and 2002 averaged 650 individuals. In early March, the eiders

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fed mainly at the depths of 15–17 m, and later preferred to stay close to the recessing ice edge. Durations of the dive bouts correlated with the depth ($p < 0.001$). Time spent underwater and on the surface was, respectively, 72 ± 3.5 seconds and 52 ± 2.2 sec. at the depths of 12 m, 41 ± 5.7 sec. and 33 ± 4.3 sec. at 6–10 m, and 21 ± 2.0 and 19 ± 2.2 sec. at 2–4 m. The foraging was most active on 8:00–11:00 a.m. and on 4:30–7:00 p.m.

In 55 samples of faeces, twenty species of benthic invertebrates and the remains of fishes and algae were found. More than a half of the samples contained polychaetes *Lepidonotus squamatus* (86 %), bivalvian mussels *Mytilus edulis* (67 %) and *Elliptica elliptica* (51 %), and tunicates *Styela rustica* (63 %). Thirty benthic samples were collected at the depths of 2 to 20 m. Mean biomass for the subtidal zone of the survey site reached 268 g/m^2. The would-be edible species made up about one-third of the total. According to the known daily consumption rate of the wintering eiders, during five months a wintering flock would consume a quarter to a half of overall accessible macrobenthos in the area. The study was supported by National Geographic Society, grant N 6972–01.

P07: Section: Population developement

P07-1 Colonization and population growth of yellow-legged gull *Larus cachinnans* in south-eastern Poland: causes and influence on native species

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We studied the breeding and feeding ecology of yellow-legged gulls breeding in the largest inland colony of this species in Poland, localized in the sedimentation basin near Tarnów (south-eastern Poland). After the first breeding pair was recorded in 1992, the population has risen to 177 pairs in 2001. The population growth rate was about 58% per year in the studied colony. The growth fits an exponential model. There were 9 localities with breeding pairs found in southern Poland and we estimated the total population size to 200–250 pairs. Clutch size, hatching success and breeding success were high in the studied colony, which indicates rich food resources in the environment. Fish, mainly carp *Cyprinus carpio*, were dominant food items delivered to nests during chick rearing stage; however there was more refuse brought to the nests during incubation stage. Food items were commonly found at nests and it is possible they were stored. Immigrants probably caused the growth of the studied colony, however our modeling has shown that natal productivity is also sufficient to maintain the studied population. We concluded that there has happened (or happens now) the inversion of sink habitats into sources in populations of yellow-legged gull at the range edge, what may cause more rapid range expansion of this species. We showed that the growing population of yellow-legged gulls might cause considerable reduction in some native species population size.

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P07-2 Population trends and breeding range dynamics in sociable plover (*Chettusia gregaria*), black-winged pratincole (*Glareola nordmanni*) and caspian plover (*Charadrius asiaticus*) in European Russia

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An analysis of original and published data during last 20 years showed a catastrophic decrease of breeding populations and breeding ranges of sociable plover (*Chettusia gregaria*) and black-winged pratincole (*Glareola nordmanni*) and caspian plover (*Charadrius asiaticus*) in the southern European Russia. The actual estimate of European breeding population of sociable plover is 10 to 50 nesting pairs. During breeding season, the sociable plover disappeared in a waste area of the Saratov and Rostov Regions and Republic of Kalmykia. The species became exclusively rare during migrations as well. The actual estimate of European breeding population of the black-winged pratincole is 5,000 to 9,000 nesting pairs. There are reports about a significant number decline of the species in various places of the Cis-Caucasus, particularly in the Kuma-Manych Depression and adjacent steppe areas. During migrations, the black-winged pratincole continues to be rather numerous, but significant numbers of birds were recorded in few staging sites only. The actual estimate of European breeding population of the caspian plover is 200 to 500 nesting pairs. However there are not reports on real records of nesting birds during last 20 years everywhere in the southern European Russia that suggest a population decline of this species. The actual population decline of three wader species is probably due to man-made transformation of steppe ecosystems but there are extremely insufficient data to explain the phenomenon scientifically.

P07-3 Do we have a stable white stork population in Eastern Germany?

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In Eastern Germany the population of the white stork (*Ciconia ciconia*) has been increasing for the last 15 years (e.g., from 1989 to 2001 by 35 percent). This was not caused by an increased breeding success because, on average, there are 1,87 fledglings per nesting pair only. Using the database of the Hiddensee Bird Ringing Center, the estimate of age-dependent survival rates does not indicate any increase either. As indicated by using a population model for simulation, estimated survival rates as well as breeding success are too small to keep the stork population stable. The unstable but increasing population of Eastern German storks depends on the immigration of a population source from another European region, which amounts to approximately 7 percent of all nesting pairs. In order to achieve a sustainable German population, it is imperative to minimize death by electrical power lines and to improve food habitats in breeding and migration areas, as demanded by the „Artenschutzprogramm Weißstorch" (Free State of Saxony/Germany).

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P07-4 Trends in african penguin *Spheniscus demersus* populations in the Western Cape, South Africa, 1992–2002

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The african penguin *Spheniscus demersus* is endemic to southern Africa. The population decreased by at least 90% during the 20th century; during the early 1990s the population was 180 000 penguins, decreasing by 2% per year. This poster reviews population trends between 1992 and 2002, based on counts of breeding pairs in the 12 colonies in the Western Cape. This period was punctuated by two major oiling incidents. In 1994, 10 000 penguins were oiled, of which 5 000 were cleaned and released. In 2000, 19 000 penguins were oiled, of which over 16 000 were cleaned and released; a further 19 000 penguins were relocated 800 km to prevent their becoming oiled. In spite of these setbacks, the breeding population of penguins in the Western Cape showed an overall average annual increase of 7.5% per year. The rate was not uniform; the trend from 1992 until 1997 was downward, with a marked increase from 1998. The breeding colonies can be split into five trend groups. One colony (Geyser Island) declined to extinction. At two colonies the population showed a strong decline, with the population at the end of the period less than half that at the beginning (Dyer Island, – 10.9% per year and Lamberts Bay, – 9.0% per year). At five colonies the population more than doubled (Vondeling Island, +15,5% per year; Dassen Island, +11.3%; Robben Island, +13.1%; The Boulders, 18.7%; Stony Point 10.6%). Three showed moderate decreases (Malgas Island, – 5.0%; Marcus Island, – 4.2%; Seal Island, – 4.9%), and one showed a moderate increase (Jutten Island, 2.4%). The pattern of increases and decreases is partly explained by changes in abundance and location of prey species.

P07-5 Corncrake and agriculture in Latvia 1996 and 2002: data and perspectives

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Habitat mapping and night counts of calling corncrakes were carried out in 16 randomly chosen sample plots in Latvia in 1996 and 2002. Corncrake number was estimated using 250 m rule (if calling males were farther than 250 m in first and second count there were interpreted as two different males). Corncrake numbers have increased in 10 sample plots, decreased in 5 and stayed the same in one plot. Overall breeding density (males per km^2) in all 16 sample plots has increased from 1,97 in 1996 to 2,37 in 2002, however this increase is not statistically significant. This is due to regional differences – numbers in three regions have increased (in two of them – significantly), but in one – decreased (not significantly). Habitats in 16 sample plots were mapped on 1:10 000 topographic maps. Area of meadows has decreased between 1996 and 2002, while area of abandoned lands has increased. Additionally corncrakes were counted in 43 free choice survey routes in Latvia during the breeding seasons of 1989–2002. The maximum number of calling corncrakes per count was used as the annual estimate of

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the number of breeding pairs. Average breeding density in the study period has grown from 0.67 (1989) to 2.08 (2002). These data show that the most rapid increase of corncrake numbers in Latvia took place before 1996. Corncrake numbers in Latvia statistically significantly correlate with several measures of agricultural intensity (e.g. pesticide use). Analyses of agricultural statistics in Latvia shows that many lands are abandoned each year and the rest are used more intensively. Both processes has negative impact on corncrakes, since intensive agriculture reduces their nesting success and abandonment of land causes habitat loss. Since both processes are occurring in Latvia, why the numbers of corncrakes are still increasing? The key is that new areas of abandoned lands are forming each year and the process has not reached the end yet, thus new corncrakes habitats are still created each year. The increase of corncrakes in Latvia and other East-European countries might have contributed to the increase of corncrake populations in Western Europe in the last years.

P08: Section: Bird communities

P08-1 Landscape structure and bird species diversity – factors influencing species richness

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The relationship between the occurrence and richness of breeding birds species and the landscape structure was investigated in a study area located in lowland of East Germany. The sampling plots create a long gradient of landscape types (from lake-land to farmland) which are under different human-impact and environmental stress linked with agriculture. The goal of analyses was to find out key landscape-related factors influencing and explaining bird species richness. The main biotopes were used as spatial data basis. The number of bird species was determined in 13 sampling plots (1 km x 1 km), which are distributed on the landscape area. The number of breeding birds was recorded during four visits. The validation of the connection between landscape properties and bird species richness is given by regression analyses. On the basis of this data analyses it is possible to determine the occurrence of bird species community according to criteria of the landscape outfit. The complex influence on bird species richness and possible combination of land use will be presented.

P08-2 Breeding bird communities in windbreaks of SW Slovakia

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Observations of breeding bird communities in eight windbreak networks of SW Slovakia within the period 1992–2001 revealed that the species richness, as well as the number of pairs and the diversity in the community increased significantly with the area of locality, whereas in the case of density, the relationship was opposite. Concerning the spatial structure, density was significantly influenced by the density of nodes (intersections and dead-ends) at the locality. In terms of vegetation structure, the number of pairs was positively related to area and number of tree species but negatively related to grass cover at the locality. The density was positively related to node density at the locality and negatively related to grass cover. Regarding the habitat selection, such species as yellowhammer, blackbird, greenfinch, lesser whitethroat were typical in homogenous, shade wind-

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breaks. Homogenous and thin windbreaks were suitable for stonechat, lesser grey shrike, corn bunting and grey partridge. Short homogenous hedges of young trees were suitable for whitethroat, red-backed shrike, pheasant. Such species as blackcap, nightingale, song thrush, turtle dove were associated with heterogenous, shade windbreaks. The windbreaks with dense old trees provided good conditions for hole nesters (tree sparrow, great tit, starling) and canopy nesters (wood pigeon, goldfinch, golden oriole, chaffinch, Serin, icterine warbler, kestrel). The results suggest that the species richness in bird community is affected by area of the locality, whereas the number of pairs and density are influenced by both, area and vegetation structure. The species composition of community is strongly dependent on vegetation structure.

P08-3 Avifauna and the human pressure's level in the Important Birds' Areas (IBA) from the Romanian Prut River basin

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The Prut River's valley was described like one of the privileged Romanian regions viewing the birds' migration important because is a really prolongation of the Danube Delta. In the Romanian Prut River basin are three important birds' areas (IBA): the accumulation lake Stanca-Stefanesti, the Jijia and Miletin's ponds, respectively, the Carja – Mata – Radeanu ponds. Beginning from the summer of 1992, were realised ornithological surveys in different points of the Romanian Prut River basin, including the three important birds areas. After 1999, our efforts were focused on these last territories. We found an unequal distribution of birds along the three important birds' areas situated in the Romanian Prut River basin. The avifauna diversity and the levels of birds' populations counted are directly influenced by the general aspect of the valleys, the habitats diversity and the size of the aquatic surfaces, the utilities of the ponds and the lakes, but also by the level of the human presence and the type of the disturbing human activities. The Stanca-Stefanesti lake is the most important birds' wintering quarter in the eastern part of Romania. The Jijia and Miletin's ponds are the most important breeding point in the studying area; represent, too, an important wintering quarter for waterfowls. The Carja – Mata – Radeanu area is very important during the migration period and a good breeding site, but the number of the pairs is small, because the houses and the farms touchs the limit of the ponds, so the human influence is very strong.

P08-4 Rarities birds' species and their status in the Romanian Prut River basin

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The Prut River represents the north – eastern and eastern border of Romania with Ukraine, respectively, Moldova Republic, from Oroftiana – Suhar?u to the confluence with the Danube River, near Galați city on 742 kilometers. From the Prut River's basin there are only few ornithological studies, beginning from the summer 1992, we visited 56 observatory points, covering all the seasons.

The birds are the vertebrates best represented in the Prut River's basin – we founded belong the years 228 species with an unequal distribution in territory. Between these, some are rare species in our country or represent species of European conservation concern, globally threatened or vulnerable species. We analyse their distribution and actual status in the Romanian Prut River basin, but

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also the efficiency of the hunting law (no.103/ 1996). We notice especially the species that are breeding here, like one of the rare points out of the Danube Delta: *Phalacrocorax pygmeus*, *Platalea leucorodia* (the only one colony out of delta), *Aythia nyroca*, *Aythia fuligula*, *Recurvirostra avosetta*, *Himantopus himantopus*, *Coracias garrulus* (the northern breeding limit in Romania), *Luscinia svecica cyanicula* (Vladeni wetland is the only one breeding point out of delta). During the migration could be seen also different rare birds' species in the Prut River basin like *Pelecanus onocrotalus*, *Ciconia nigra*, *Branta ruficollis*, *Haliaeetus albicilla*, *Numenius tenuirotris*, etc.

P08-5 Effects of eutrophication, weather and other environmental factors on archipelago bird abundance

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We analysed the relationship between archipelago bird abundance and diversity and environmental factors, e.g. eutrophication, water salinity, winter sea ice coverage and weather factors. As birds are considered to be good indicators for environmental changes, it is important to understand the relationship between changes in bird abundance and major environmental changes.

The water quality data were collected by the Southwest Finland Regional Environment Centre and the Water Protection Association of Southwestern Finland at 24 water quality monitoring stations in the Archipelago Sea, SW Finland. Data on water salinity and sea ice coverage were attained from the Finnish Institute of Marine Research and weather data from the Finnish Meteorological Institute. Data on archipelago bird numbers were collected on the island Aasla, Rymättylä, SW Finland. The data covered the years 1980 – 2001. We used principal components calculated from water quality data to examine the relationship among water quality factors, and to describe the eutrophication status of the Archipelago Sea. The principal component analysis was found to be a practical tool to summarise environmental data including many variables. We used principal components calculated for ten water quality stations near the island Aasla to study the relationship between the eutrophication status of the sea and bird numbers and diversity. Into this analysis we included also data on water salinity, sea ice coverage and weather factors in order to put eutrophication in perspective with other factors, which potentially affect marine bird population sizes. The results of the analyses are discussed more thoroughly in the presentation.

P08-6 Changes in bird species diversity at the reed bed – forest interface, a case study from Comana wetland, south Romania.

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We studied seasonal changes in bird community at the sharp, uninterrupted interface (6 km long) between an unfragmented mature broad-leaved forest and a reed bed compact area, with little or no transitional vegetation. Bird community diversity was compared for two moments of maximum

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densities: the end of reproductive period, (post-fledging, before the migrants' post-reproductive dispersion) and the beginning of winter (after the residents' dispersive movements). The presence of reed-nesting migrants in summer resulted in a higher overall species richness and a lower evenness, the latter caused by the high relative density (assessed by line transect sampling) of the reed warbler (*Acrocephalus scirpaceus*): 51.1 ind./ha, SD = 14.16. Resident species diversity was lower in summer, both in terms of species richness (rarefaction analysis) and evenness. During winter, the most abundant resident species using reed bed edge were blue tit (*Parus caeruleus*): 7.1 ind./ha, SD = 2.78 and wren (*Troglodytes troglodytes)*: 7.1 ind./ha, SD = 1.4. About 25% of the species observed at the forest-reed bed interface throughout the year are able to exploit for foraging both habitats. The sharp transition between forest and reed bed (without typical transitional vegetation) favors during winter the access of forest residents (mainly *Parus caeruleus, P. major, Dendrocopos minor, D. major, D. medius*) to the supplementary trophic resources existing in reed. The same applies during summer in the reverse direction, for some reed-nesting species (*A. arundinaceus, A. scirpaceus*) that can use the forest edge for feeding and perching.

P09: Section: Miscellaneous

P09-1 Phylogeographic differentiation of passerine bird species on the Canary Islands

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Due to their oceanic origin and volcanic history the Canary Islands, Spain, offer interesting opportunities for investigations of evolutionary and phylogeographic questions. Based on mitochondrial cytochrome b-sequence data we analyse the degree of differentiation among island populations as well as between island and mainland populations of several passerine bird species. Our main targets are to investigate the colonization pathways, origins of the Canary Island populations, a timescale for the colonization events and a discussion of the different strategies involved. The results from genetic data are compared to analyses of morphometric measurements obtained from live birds. Here we present our first results for some widespread species like e. g. the European robin (*Erithacus rubecula*) and Sardinean warbler (*Sylvia melanocephala*).

P09–2 Results of using method of morpho-functional analysis of jaw apparatus in study of Life history of bulbuls (Pycnonotidae) in Vietnam

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Totally 16 species of bulbuls (Pycnonotidae) were studied with the use of traditional field methods and morpho-functional analysis of their jaw apparatus. Field data collected in more than 10 locali-

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ties of Vietnam during 24 months and consist predominantly of data on feeding with additional information on breeding, density, habitat and plant layer distribution, etc. The morpho-functional analysis included the total study of skeleton, muscle and ligament elements of jaw apparatus and biomechanical analysis of their work for all 16 species. Revealed trophic adaptations of the studied species show that bulbuls are typical omnivorous birds which exploit arthropod, small fruits and nectar. Bulbuls can use two different ways of jaw-manipulation: common way of co-ordinated pressing of food-piece when both jaws work with equivalent forces, and the other one when upper jaw acts independently to overcome the force of strength by tearing fruit away, as in some Non-passerine birds (with different construction of jaw apparatus). Such morphological adaptations to frugivory is firstly described for Passerines. It was developed on the „insectivorous" morphological basis typical for other Passerines. A description of morphological diversity of jaw apparatus of the studied species and knowledge of fundamental, basic trophic adaptation of bulbuls lead to conclusions about systematics of the group, their participation in seed dispersion and some other biological features.

P09-3 Application of morphometric data to the study of seasonal distribution (the case of chaffinch *Fringila coelebs* subspecies wintering in the Caucasus)

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Three chaffinch subspecies differ in their bill size. Bill of *F. c. caucasica* breeding all around the Caucasus excluding W part of the Greater Caucasus and Black Sea coast is longer and more massive than that of *F. c. coelebs* breeding in most of Europe. Bill of *F. c. solomkoi* from S Crimea and the W Caucasus south to 43∞N is significantly deeper and wider than that of *F. c. caucasica.* All these subspecies winter in the Caucasia region but their numbers vary at particular localities. The study was conducted during two winter seasons in Abkhazia (E Black Sea coast) where *F. c. solomkoi* breeds in the N and *F. c. caucasica* in the S with a certain introgradation zone. Measurements of length of bill from nostril, depth and width of bill at feathering were taken from 156 trapped chaffinches in 2002 and from 117 in 2003. The results were compared with the data obtained on the Courish Spit of the Baltic Sea (n = 202) where only the nominotypical subspecies of chaffinch occurs. Means from birds in Abkhazia were significantly larger than that from chaffinches on the Courish Spit in all cases (3 measurements in males and in females), e.g. length of bill in males was 9.8 (n = 140) and 9.46 mm (n = 101), respectively, $p < 0.001$. Measurements from chaffinches on the Courish Spit are nearly normally distributed, while measurements from wintering Abkhasian birds sometimes show two peaks. This may suggest that at least two subspecies are present in the sample. Meanwhile in Abkhazia bills of males were significantly longer and deeper in 2003 than in 2002. This could result from a larger proportion of *F. c. coelebs* penetrated into Transcaucasia during the snowy winter 2001–02 in Northern Caucasia. The possibility of subspecific identification of individual birds (and thus breeding area adjustment) on the basis of bill morphometry is also discussed. Now we can reliably identify only 80% of individuals. The further work requires study of breeding Caucasian populations (preferably alive, but also in collections)

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that will make it possible to use discriminant analysis, mapping of morphometry data from different seasons and desirably the analysis of DNA.

P09-4 Growth of the wing- and tail-length in the barn swallow *Hirundo rustica* and reed warbler *Acrocephalus scirpaceus*

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Growth of metric traits in passerine birds are well described in nestling, also are known differences in average value of traits between juveniles and adults birds. Long-term study on growth in adults birds are rarely performed. In the paper relationships between age of birds and the wing and tail length in two species of passerines were described. Average increases of the metric traits between consecutive age classes of birds were calculated. The average increments were the basis to estimation the nonlinear regression models, which show the dependence between age of birds and length of metric traits. The regression equation have been calculated separately for males and females. Wing length in males and females of both species significant increased between first (1Y – juveniles) and second calendar years of birds life (2Y). In barn swallow males wing-length increased up till 5Y; in females up till 4Y. The increase of wing-length in reed warbler appears up till 4Y in males, and up till 3Y in females; in the next years of birds' life (5–7Y) the wing-length decreases. Also the changes in tail-length with age of birds in the both species were similar. Longest average increments were noted between 1Y and 2Y class of birds. Tail-length in swallow males increased up till 3Y, and in females up till 4Y. In reed warbler males tail-length increased up till 5Y; in females up till 3Y. The differences between growth of wing and tail are the results of heritability of the traits.

P09-5 Effects of risk on the long- and short-range call use in crested tits, *Parus cristatus*

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To examine the relationship between predation risk and the use of long- and short-range communication calls in free-ranging crested tits, Parus cristatus, we recorded the frequency of calling at two nearby feeding sites differing in safety. Calling rates of the long-range calls were highest when foraging at the safe site. The frequency of utterance of short-range calls did not differ between safe and risky sites. Giving loud long-range calls is a conspicuous behaviour that attract predators while high-pitched short-range calls are less costly in terms of predation. Our results suggest that crested tits can decrease their exposure to predation by choosing less risky type of communication. We can admit that short-range calls evolved as a „predation free" communication system.

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P09-6 Song of reed warbler as marker of a wetland habitat

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We used tape luring method for studying of habitat selection in birds. During three field seasons in atypical habitat for *Acrocephalus* species (on sand dunes covered with willow scrub with single small birches and pines) we played species songs of reed warblers (A. scirpaceus), sedge warblers (*A. schoenobaenus*), redwings (*Turdus iliacus*), pied flycatchers (*Ficedula hypoleuca*) at nighttime. Attracted and landed birds were caught by mist nets, which surrounded of loudspeakers. The nets were checked by torchlight at the end of each hour. We attempted to elucidate the following topics: (1) whether conspecific song uses as marker of wetland habitat for reed and sedge warblers during spring and fall migrations; (2) whether heterospecific songs are markers of a habitat; (3) are there age-specific differences in reaction on acoustic stimulus during habitat selection. On analysis of distribution of caught birds when two acoustic stimulus were presented, we conclude that there are strong species differences in reaction on tape luring. Differences in an attractive level depend on habitat preferences of studied species. Here mechanism of habitat selection of young *Acrocephalus* species is discussed. It is suggested the participation of endogenous knowledge of species song. Also, it is considered the reasons for allurement of reed warbler song for other species.

P09-7 Habitat suitability models for barn owl *Tyto alba* and little owl *Athene noctua* in East-Flanders (Northern Belgium) at three spatial scales. A comparative approach between two owl species

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A Barn Owl *Tyto alba* population census was performed from 1986 till 2001 in East-Flanders, northern Belgium. A total of 182 UTM-squares of 500 x 500 m were found at least once occupied. A Little Owl *Athene noctua* population census was performed using playback from 1998 till 2000 in the same area. A total of 2264 squares were surveyed of which 1011 were found to be occupied. The breeding location (282 m radius; 25 ha), the territories (564 m radius; 100 ha) and the active range (2 km radius; 1256 ha) of all occupied areas were studied for the Barn Owl. The locations that were surveyed at least 5 times were classified as high or low quality depending on their occupation ratio above or below 50%. A discriminant analysis allowed to identify the most discriminating landscape parameters between high and low quality locations and yielded a correct classification of 92% of the breeding locations, 95% of the territories and 99% of the active ranges. For the Little Owl a habitat suitability model was estimated using the information of the occupied and unoccupied squares. A discriminant analysis allowed to identify the most discriminating landscape parameters between occupied and unoccupied squares and yielded a correct classification of 64% of the breeding locations, 65.8% of the territories and 65.5% of the active ranges. The use of the discrim-

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inant analysis and the extrapolation of the quality for infrequently surveyed locations and for the rest of East-Flanders is discussed in terms of sustainable long-term conservation by volunteers. The differential impact of landscape parameters on different spatial scales is further discussed in terms of Barn Owl respectively Little Owl ecology. Differences and correspondences in habitat selection between both species are discussed.

P09-8 Penguins as food patches for brown skuas

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Brown skuas (*Catharacta antarctica lonnbergi*) can forage on penguins, their eggs and chicks. Hereby, some skua pairs monopolise feeding territories in penguin colonies and have therefore exclusive access to food. The territorial owners defend their feeding territories throughout the reproductive period of the penguins, and hence should be informed about potential food patches (penguin chicks) at any time. Therefore, we expected that territorial skuas use each food patch up to a certain exploitation stage and afterward they should search for a new, more profitable patch. To test this hypothesis, we experimentally offered penguin chick carcass of different mass to skuas and observed their foraging behaviour, i.e. patch exploitation patterns and time present at the food patch as well as their feeding rates. Additionally we estimated skua's prey choice by recalculating body weights of preyed penguin chicks. Patch profitability as well as skua' feeding rates decreased exponentially with exploitation time. Territorial skuas were generally feeding during the whole experimental time, but their mean presence declined from 70% to less than 48% in the course of patch use. Hence, most of territorial owners exploited food patches irrespective of their profitability. The reconstruction of penguin chick-mass confirmed a selective prey choice in skuas: penguin chicks larger than 3.2 – 3.5 kg were not considered as food. Therefore, skuas have to cope with limited food supply at the end of penguin reproductive period, when penguin chicks reach their fledgling size. In that time, searching for and killing of unexploited food patches is very time consuming for skuas and hence, the complete exploitation of an occupied food patch independently of patch profitability is adaptive.

P09-9 New data about an ecological role of migrating birds

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Our researches in 1997–2002 for the first time have shown, that non-parasitic soil inhabiting oribatid mites permanently meet in feathers of birds inhering to miscellaneous taxonomic and ecological groups (2100 individuals of 150 species were inspected). We reveal 180 *oribatei* species and also other non-parasitic microarthropods in feathers. This appearance was not known before our researches. Many of *oribatei* reproduce in bird feathers, that were proved by us. Even the marine birds transfer oribatei in the plumage. On our view this data represent doubtless concern for biogeography of oribatid mites and birds-carriers of mites, as biomarkers of their geographical populations and flyways. The cases of carrying of *oribatei* by birds for limits them areas are detected: *Herman-*

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nia reticulata from the north on the south of Europe by *Cygnus olor*, and Mediterranean *Sphaerochthonius splendidus* by *Crex crex* in Byelorussia. *Oribatei* ecology, living in bird feathers, while is unknown, but as all of them are microphages, it is possible to suspect, that they feed on funguses, which one live on the bird's feathers and skin. Birds making long-distance overflies, in particular marine and waterfowl, represent the special concern by reviewing a problem about distribution of oribatei. They adhere on migratory paths, in places of reproduction and wintering to biotopes similar on conditions of humidification, where it would be easier to portable microarthropods all to be naturalized. The carry of these microarthropods by birds can be the defining factor of their moving, especially in Arctic, on islands and oases of deserts.

P09-10 Prevalence of blood parasites in European Passeriformes

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Factors explaining variation in the prevalence of blood parasites (proportion of individuals infected) among species of birds are poorly understood. We assessed the effects of habitat, population size, geographical distribution, and life history parameters on prevalence of *Plasmodium*, *Haemoproteus*, *Leucocytozoon* and *Trypanosoma* in European passerine birds. Most of the variation in parasite prevalence occurred among species within genera rather than among higher taxa. Body mass and geographical distribution explained 20% of the total variation in prevalence. Moreover, species with greater maximum longevity had higher parasite prevalence, as did species with brighter males. These results suggest that prevalence is influenced by both ecological factors (e.g., vectors) and intrinsic factors (e.g., immune responsiveness), but that more labile, genetically controlled aspects of the host-parasite interaction create most of the variation in parasite prevalence on small temporal and spatial scales.

P09-11 How many immigrants are there among immigrants?

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The estimation of a proportion of immigrants in each population of birds is an intriguing problem in ornithology. Banding recoveries cannot answer this question, as recovery probability is usually low. To answer it, other population tags, which would make possible to distinguish local birds from immigrants, are needed. For the Courish Spit (Lithuania and Kaliningrad Region of Russia) such a tag was found during long-term parasitological studies (VALKIUNAS 1988, 1997). These are blood parasites from the genus *Leucocytozoon* (Leucocytozoidae, Haemosporida) which are widespread in the Northern Palearctic. The leucocytozoids have never been found in the blood of birds hatched on the Courish Spit because of the lack of transmission at the study site due to the absence of the parasites' vectors (blood-sucking simuliid flies from the family Simuliidae, Diptera). Passerines migrating through the Courish Spit are infected with *Leucocytozoon* spp.; the prevalence of infection in different species vary between 10 and 80%. For birds wintering in zone of cold winters, the probability to be infected during migration and wintering is close to zero, as vectors are not active during the time of stay of migrants there. Once infected with *Leucocytozoon* spp. bird become a carrier of parasite for the rest of its life (VALKIUNAS 1997).

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In total, 224 birds belonging to four titmice species were investigated by microscopic examination of stained blood films which were collected during the birds' breeding period in 1989–2002. All birds were captured at nests. Their origin was unknown. Of 114 great tits (*Parus major*), 41 (35.9%) were infected with *Leucocytozoon* sp. In the blue tit (*P. caeruleus*), the prevalence of infection was 42.3% (11 out of 26), in the coal tit (*P. ater*) it was 3.2% (one out of 31). The parasites were not recorded in marsh tits (*P. palustris*). In the great tit, the material facilitates estimating prevalence of infection in different sex and age groups: adult males (25%), adult females (44.4%), yearling males (26.7%) and yearling females (36.9%). Proportion of inflected birds supplies the minimum share of immigrants arrived a distance of at least 30 km. It is impossible to distinguish non-inflected immigrants and unbanded autochthons.

P09-12 Is there a life after fledging? No, colliding with aircraft is fatal

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Aircraft and birds have been colliding since the first flight of the brothers Wright, resulting in US $ 1.2 billion material damage each year and priceless loss of human lives; birds always die. We counted the number of birds flying in a defined air volume, i.e. density of flying birds above Eindhoven Airbase, The Netherlands. The catch volume of aircraft, i.e. the volume of air struck by aircraft taking off and landing at the airbase, was also calculated. Multiplying the density of flying birds with the catch volume of aircraft gave the expected number of bird strikes. Comparison of this number with the actual bird strike number showed that bird species and season were important factors in determining the probability of bird strikes. Some species collided as many times as expected, others less. In winter less birds collided as expected than in summer. Do post-fledging birds collide more often with aircraft than older birds? Bird strike data, birds' flying behaviour and needed fieldwork will be discussed.

P09-13 Development of a new technique for the remote assessment of bird diets using natural chemical markers

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Increased grazing by livestock in the uplands, and agricultural intensification within both lowland and upland areas, are believed to be contributory factors in the decline of many bird species in Great Britain. To design strategies to prevent further decline, we must be clear what resources these species require from their environments. Identification of invertebrates in the diet of birds, for example is critical for predicting population responses to changes in food availability. Conventional techniques such as microscopic faecal and pellet analysis and direct observation often provide inaccurate or incomplete estimates of adult and chick diet. Other techniques, such as neck collaring, while providing accurate estimates of diet, can only be used for measuring chick diets. This study introduces a novel

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technique, based on natural chemical markers, and investigates the potential of this technique as an improved descriptor of bird diets in comparison to established methods. The markers used are representatives of compound groups such hydrocarbons which are found both internally and externally on invertebrates. These types of compounds are commonly used for taxonomic identification of invertebrates. The development of this technique shall emphasise the use of characteristic markers in available insect prey and in bird faeces, in order to determine those invertebrates most important for a key bird species of uplands in the UK – the meadow pipit.

P09-14 EURING Protocol Engine (EPE) hosted by Ozzano Ringing Centre

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The EURING domain of ringing data has flown from the italian ringers to the Ozzano Ringing Centre (IAB) with a dishevelled semantic rigour, by means of a scanty transfer automation, in many strictly one-way point-to-point centripetal streams. Emancipation process from these shortages requires new technological tools, now available in the emerging „second generation Web" framework: EPE implements this framework. The first requirement is data quality improvement through rigorous imposition of data semantic homogeneity throughout ringing data domains as a whole, in the countrywide context. A (.NET) application running on the ringer's pc (connected or disconnected from the web) will achieve this objective collecting and rigorously validating it against metadata scheme. The second requirement is a full digital automation of data flow improving management expenditure and time for the answers. This feature will be achieved introducing a reciprocal web synchronization (SOAP) between ringers databases (MSSQL) and central data bank (ORACLE) gluing valid data of different ownership. The last requirement is to improve the overall management flexibility and the analytical potential for the scientific collaboration between ringers. EPE will have an HTML GUI powered by a web server (JSP/Servlet) that will ease the human resources management, the whole system administration, the process of formally abdicated data validation/acquisition, and offer a powerful query engine of the ringing data reporting in various formats (HTML, MDB, PDF, TXT, XML, RDF).

P09-15 The Euring Exchange Code: from an exchange format to a distributed resource

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The Euring Exchange Code has been for a long period a powerful tool for data exchange among the European ornithological community. We propose here a major technological and conceptual update of the code. The code in fact at the moment operates as a method to dispatch data from and to subjects that have previously and, from a technological viewpoint, informally agreed on the code itself. In the last years one of the major focuses of the information technologies developers has been data sharing across distributed systems and the concept of fixed length record has been obliterated by XML and various XML idiolects. The outstanding benefit of this approach is that in XML metadata

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is inherently embedded so there is no need for a previous agreement. Data definition is formally stated from a technological viewpoint. Two complementary strategies are here proposed to upgrade the code: XML Schema and RDF Schema:

(http://moro.imss.fi.it/nest/epe/1.0/xmls/Identification.xsd)

(http://moro.imss.fi.it/nest/epe/1.0/rdfs/Identification.rdfs).

XMLS may be thought of as a method to formally define the Euring Exchange Code, in his various past, present and future versions. RDFS is a more elaborate tool that serves as a knowledge base definition accessible and linkable from other distributed resources. Writing an RDFS extending the Euring Exchange Code implies a conceptual analysis of the systematic categories underlying the code itself and taking a position in this domain: criticism or alternative positions will result in different approaches that may coexist in an environment of distributed resources.

P09-16 Heavy metals and organochlorine residues in water birds from Romania

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Four heavy metals (Zn, Cu, Pb and Cd) were analyzed in the pectoral muscle and liver from mallard (*Anas platyrhynchos*) and teal (*A. crecca*) wintering in Transylvania, Olt River Basin, Romania. Only zinc and copper were found (100% occurance).The levels were higher in liver than in muscle. Zinc had higher concentrations than cooper for both tissues. Copper levels were situated below 10 ppm but the zinc levels were in general higher than 10 ppm. Among tissues the only significant differences ($p < 0,005$) were between cooper levels in pectoral muscle. These analysed ducks were not poisoned with lead according this investigation. The content of seven black-headed gull (*Larus ridibundus*) eggs were investigated in organochlorine contaminants (alpha-HCH, betta-HCH, gamma-HCH, total DDT). These proceed from a breeding colony near Olt River, SE Transylvania. The occurance was maximum for HCH isomers and total DDT had the highest level. Only alpha- and betta-HCH were significant correlated ($p < 0,005$).

P09-17 Effects of disturbance on two Antarctic seabird species – analysis of faecal hormones

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Variable environmental conditions and human disturbance can be stressors to seabird species with short breeding seasons in extreme climates such as Antarctica. The production of corticosteroids, as hormone response to unpredictable events, can modify the normal behaviour of the animal having negative consequences for reproductive or territorial efforts, but may increase own survival chances. We investigated the impact of visitors and air traffic on two species of Antarctic breeding birds, southern giant petrels (*Macronectes giganteus*) and skuas (*Catharacta* spp.) on King George Island (South Shetland Islands, Antarctica). As blood sampling would cause additional handling stress, a non-invasive method of analysing corticosterone metabolite concentrations in faeces of

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birds was used. Comparisons within and between the species in study areas with different disturbance levels were made. Furthermore, it was tested if effects of habituation in more frequently disturbed breeding sites can be shown by the hormone analysis.

P09-18 Effects of disturbance on two Antarctic seabird species – analysis of behaviour and heart rate

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Breeding sites of Antarctic seabirds concentrate in a few ice-free areas which are increasingly used by humans. Intensive station activities and growing tourism can lead to reduced reproductive success and survival of birds. For designing effective management plans for the protection of certain species, it is necessary to collect scientific information to human impacts. We studied the effects of aircraft and visitors on southern giant petrels (*Macronectes giganteus*) and skuas (*Catharacta* spp.) breeding on Fildes Peninsula (King George Island, South Shetland Islands, Antarctica). Heart rate levels and behaviour were analysed simultaneously through non-invasive techniques such as stethoscope microphones in the nests and video recording. During the observation time, birds were experimentally subjected to helicopter noise and standardised visits by the investigator. Additionally, all air traffic, visits by station members or tourists as well as potential interaction with other birds were documented.

P09-19 Puffin harvesting and survival at Nòlsoy, Faeroes

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On the Faeroes there is an old tradition of fowling for birds. The annual „fleyg" netting of puffins in the colonies tended to select for non-breeding young birds. Usually 5 fowlers catch up to 800 puffins/day (c.10 thousand birds per season) in the Nòlsoy colony for July-August, from 8–14 h, when birds fly with food from the sea to colony. Continuous decline (since 1900) of the number of breeding birds and shrinking of the colony area strongly suggest serious overexploitation of the local population. In 1997 at Urdine colony on Nòlsoy we ringed 184 puffin fledglings. In total we recovered 36 (19,6%) rings from birds caught by fowlers on Nòlsoy (33 birds) and on other Faeroe islands (3 birds). First 8 puffins were fowled at colony in 1999 as 2 years old, most of them (55%) in 2000 (3y old) and the final 2 were killed in 2002 as 5y old birds. Ringed puffins which have been harvested, i.e. those which survived at least 2 years, were on average larger and heavier at fledging than the rest of the ringed chicks. Most of them originated from early broods and least from late broods. Our data suggest that adult puffins breeding earlier produce better quality offspring which survive in higher proportion. We discuss the results of the study in the light of the existing practice and make some postulates towards the sustained puffin harvest.

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