SYMP13: Behavioural ecology of dispersal

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Although most of the major hypotheses on vertebrate dispersal have been formulated in the early 1980s (e.g. GREENWOOD's hypothesis on resource defense, inbreeding avoidance, habitat saturation), the causes and consequences of dispersal are still not well understood for most bird species. The increasing amount of data at the level of both individual behaviour (e.g. from radiotracking data) and populations (from long-term studies taking larger scales into account) should help to fill some of these gaps. Moreover, new hypotheses have been formulated based on more insight in spatial structure of populations and in the roles of local adaptation, landscape effects and metapopulation processes. In this symposium we want to bring together different approaches aiming at identifying proximate and ultimate factors that can explain variation in dispersal patterns between species, populations and individuals.

SYMP13-1 Comparing before settling: Attendance patterns of prospecting common terns (*Sterna hirundo* L.) at two colony sites

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The complete cohorts 1999 of two neighboured common tern colonies were marked individually with passive transponders to observe the spatial attendance patterns of these birds at both sites in 2001 when a high percentage of individuals returned as pre-breeders (prospectors). The sites are about 4 kms apart from each other and comprised 30 (site ‚Marinearsenal') and, respectively, 235 (site ‚Banter See') breeding pairs. A system of special antennas allowed automatic recording of transponder-fitted birds at both sites throughout the breeding season. For the bigger colony, presence and breeding status of terns has been recorded also in the following years. For almost all birds, the sex is known. 55% of pre-breeders born at the colony Banter See (N = 153) were recorded only at their home colony whereas only 6% of Marinearsenal pre-breeders (N = 32) did so. 44% of Banter See born pre-breeders and even 75% of birds from Marinearsenal visited both colonies. This indicates a much higher attractivity of the bigger colony and shows that, despite of a high breeding-site fidelity of breeding common terns, prospectors indeed attend several potential breeding sites. Furthermore, changes in time spent by individuals in both colonies indicating the process of selecting a potential future breeding site are presented with respect to sex. Prospectors recorded mostly at the Banter See were more likely to settle there as recruits in 2002 than prospectors that had spent more time at Marinearsenal. Supported by the Deutsche Forschungsgemeinschaft.

SYMP13-2 Dispersal in relation to spatiotemporal heterogeneity in blue and great tit (*Parus major, P. caeruleus*) populations

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In a spatiotemporally variable environment, dispersal can be an adaptive strategy from the individual's point of view (optimizing habitat selection) and/or from the parents' point of view (e.g. bet-hedging strategy). We analyzed dispersal data of blue and great tits (*Parus major, P. caeruleus*) in a study area of 13 forest patches where up to 50% of first-year birds (depending on sex and species) recruit inside the study area, and roughly half of these move between patches. Within the area, habitat quality varies spatially (patch size, different forest types) and temporally (year effects) and is affected by population densities which fluctuate asynchronously between patches. We will determine the major determinants of fitness and test hypotheses on adaptive dispersal by great and blue tits in relation to these factors, by analyzing patterns of dispersal as well as exploring fitness consequences for dispersers vs. residents.

SYMP13-3 Causes and fitness consequences of natal dispersal in red-cockaded woodpecker (*Picoides borealis*)

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Natal dispersal is a key process with a multitude of causes and consequences for individuals, populations and communities. In animals, environmental and social factors have often been associated with natal dispersal distance, whereas evidence for genetic influences is scant. Theoretical models assume natal dispersal to be costly, for example in terms of survival or fecundity, but empirical support with respect to natal dispersal distance is hardly available. We report significant heritability of natal dispersal distance in the red-cockaded woodpecker and further show that environmental and social factors affect natal dispersal distance. Although lifetime reproductive success was negatively related to natal dispersal distance in males, neither adult survival nor lifetime recruitment rates were so in either sex. Our findings suggest that in birds natal dispersal distance may indeed have a genetic basis, but that the presumed fitness costs of dispersal distance may be rather modest.

SYMP13-4 Buzzards (*Buteo buteo*) in space and the role of the family

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Only half of the juvenile buzzards *Buteo buteo* in Dorset, UK, disperse from their parent's territory in the first autumn, therefore territorial breeders appear to tolerate juveniles. But what happens to the juveniles that disperse? Do unrelated breeding adults tolerate them, or are they pushed to marginal habitat? Indeed do non-breeders have territories or are they forced to live communally? We found that dispersed buzzards settled on average 0.9 km from the nearest nest, significantly ($P < 0.001$) further than those remaining at home (0.5 km), but still settled within the nesting area rather than in poor habitat nearby. So breeding birds appear to recognise and tolerate

their own offspring. Also siblings settled closer to each other ($P < 0.002$) and overlapped more of their home range even in the central core in their first year. However, by their second year all tagged buzzards only overlapped their ranges in the outermost cores, retaining a small exclusive core of 56 ha.

SYMP13-5 Relationship between realization of juvenile dispersal in the reed warbler (*Acrocephalus scirpaceus*) and weather conditions

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Extensive studies of juvenile dispersal in the reed warbler *Acrocephalus scirpaceus*, conducted recently in the Biological Station Rybachy, revealed that in this species juvenile dispersal takes place between isolated reed patches by non-interrupted flights at night in the age of birds in 33–49 days. During dispersal birds have low fuel stores and are in active moult. To study relationship of juvenile dispersal in the reed warbler with weather, we analyzed the data on young birds (1) with active moult, (2) with the known natal site and age till 50 days, which were tape-lured at night in late July – mid September 1999–2001 on the Courish Spit on the Baltic Sea in an atypical reed warbler habitat – on sand dunes covered by willow bushes. We tested the following weather factors: relative humidity, air temperature and pressure during different periods of night and their trends, visibility, precipitation, cloud cover, wind velocity, pressures system in nights with captures. The analysis of relationship between night-to-night number of birds captured and weather conditions showed that to minimize flight costs and to have optimal conditions for selecting landing sites dispersing birds preferred to make nocturnal movements in high pressure systems, in still air or with slow winds.

SYMP13-P1 Modelling between-patch dispersal in great and blue tits: distance and matrix connectivity

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A challenging question in landscape ecological studies is to document the impact of landscape structure on dispersal flows of organisms. We studied the effect of patch size, distance between patches, and permeability of the matrix between patches (i.e. landscape connectivity) on dispersal rates of great and blue tits (*Parus major*, *P. caeruleus)* between small patches (1–12 ha) of forest supporting high breeding densities in nestboxes. Landscape connectivity was modelled by means of the 'least cost' routine CostDistance in ArcView which, for any combination of patches, calculates the cumulative landscape resistance (or ‚cost') along the optimal path between the patches. Lowest resistances were assigned to land-use classes containing wooded vegetation (forest, hedgerows, ...), while open areas (grassland, water, ...) and built-up areas received higher resistance values. Different sets of resistance values were considered and the resulting 'least cost' estimates were used as explanatory variables in a statistical model designed to explain between-patches natal dispersal frequencies. The comparison of the fit of the models to the data obtained with contrasted sets of resistance values allowed to assess the relative permeability of the various landuse classes regarding natal dispersal of tits.

SYMP13-P2 Testing hypotheses on dispersal: the problem of spatial autocorrelation

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In a finite study area, expected patterns of dispersal covary with birth sites because the distribution of observable distances and directions strongly depends on the point of departure. This complicates statistical tests comparing observed patterns with null expectations. Here we present two examples testing such hypotheses on great and blue tit (*Parus major, P. caeruleus*) dispersal in a finite and highly patchy study area. In a first analysis we tested if dispersal directions are independent of the point of origin inside a patch. By comparing the observed dispersal directions from a focal patch with those obtained from permutations of all dispersal events originating from the same patch, we were able to show that dispersal direction is correlated with the birds' position relative to the patch centre, i.e. tits tend to disperse in the direction of the nearest boundary. In a second analysis we tested if siblings resemble one another in dispersal distance and direction, by comparing sibling dyads with control dyads of unrelated birds born in the same patch. Siblings did not move over similar distances relative to control dyads, but they tended to move in similar directions, and as a consequence were found breeding at significantly closer distances to one another than expected. In both cases, departure from the null expectation was found in great tits but not blue tits. A tentative explanation may be found in the parental escorting behaviour in great tits, which may influence spatial dispersal patterns through a pre-dispersal familiarization process.

SYMP13-P3 Dispersal in grouse

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Capercaillie and black grouse are endangered species in most western and central European countries. Their distribution ranges are highly fragmented, and many populations are small and spatially separated, dispersal may therefore play an important role for the dynamics and persistence of populations and metapopulations. Information on dispersal patterns however is lacking.

In the past, dispersal studies on birds had to rely on classical methods such as radio-tracking or banding. In grouse species, which are difficult to observe and trap, population studies present only anecdotal data on dispersal rates and distances. Advances in molecular biology now allow us to gain genetic information on populations by analysing feathers or faeces.

Using noninvasive sampling, I studied spatial structure of capercaillie and black grouse populations in the Alps. I estimated gene flow among populations with genetic markers (microsatellites) to identify isolated and still connected populations. Genetic effects of habitat fragmentation and range contraction could be observed on multiple spatial scales. Genetic differentiation and effects of isolation by distance are more pronounced in capercaillie than in black grouse, which are known to have longer dispersal distances. Results of such studies help to develop management and conservation plans especially for endangered bird species.