

## Abstracts of wader theses

As a means of disseminating information about important new wader studies well in advance of formal publication, this series features abstracts from recent wader theses (bachelors, masters and doctoral). Thesis authors are invited to submit abstracts to the editor.

### **Individual wintering strategies in the Eurasian Woodcock (*Scolopax rusticola*): energetic trade-offs for habitat selection.**

(2003, Ph.D. thesis, Laboratoire d'Ecologie, Université Pierre et Marie Curie – Paris VI, Paris, France)

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The Eurasian Woodcock (*Scolopax rusticola* L.) is a migratory bird species with an uncertain conservation status, whose ecology and behaviour are mostly unknown in winter. Woodcocks are known to be sensitive to frost, and are threatened by habitat loss and high hunting pressures in winter, which is a period of enhanced vulnerability due to the concentration of populations. This study aims to understand the behavioural strategies in winter by combining eco-physiology and behavioural ecology approaches, to propose accurate management and conservation measures.

Birds must resolve a trade-off between feeding and predator avoidance according to their energetic requirements. The trade-off could thereby impact on habitat selection. Studies of energetic expenditures in laboratory (basal metabolic rate and thermoregulation) and in the field revealed that woodcocks were well insulated and had a rather low energy expenditure compared to other wader species.

Woodcocks live in two types of habitat in winter: wooded habitats during the day (woodland and hedges) and agricultural habitats at night. Habitat selection, spatial use, survival and time-budgets were studied during three winters in Brittany, using about 100 woodcocks fitted with radio-transmitters. Diurnal habitats were selected according to their richness in earthworms (their main food item) and shrub

cover (for protection). At night, grazed meadows were preferred to crops for their richness in earthworms. Natural mortality by predation occurred mostly in the fields at night and survival rates suggested an additive mortality due to hunting.

The trade-off between starvation and predation risk leads individuals to adopt different behavioural strategies of space use and time-budget management. Some individuals only used one site while others visited several sites, alternatively or successively. The choice of strategy seems to depend on the efficiency of individuals in foraging and escaping predators. The use of meadows at night, which varies among individuals, gives another explanation for the starvation/predation trade-off. Depending on their energetic needs (function of air temperature) and their own foraging efficiency, individuals that increased their foraging effort during the day, could decide to stay in the forest at night in order to minimise predation risks.

These results are discussed in scientific and conservation perspectives. Solutions of habitat management are proposed for a sustainable use of woodcock populations.

This thesis is available online in PDF at the following address: [http://tel.ccsd.cnrs.fr/documents/archives0/00/00/35/09/index\\_fr.html](http://tel.ccsd.cnrs.fr/documents/archives0/00/00/35/09/index_fr.html)

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### **The impact of macroalgal mats on the feeding distribution and feeding behaviour of mussel feeding birds on the Ythan estuary, Aberdeenshire**

(2002, Ph.D. thesis, University of Aberdeen, Scotland, UK)

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This thesis describes the feeding distribution and feeding behaviour of two species of mussel-feeding birds, Common Eider *Somateria mollissima mollissima* L. and Eurasian Oystercatcher *Haematopus ostralegus* L. on intertidal mussel beds of the Ythan estuary, Aberdeenshire, in relation to the distribution of green macroalgae during different phases of growth. Environmental variables (macroalgal abundance and prey abundance), population variables (predator abundance) and behavioural variables (predators' feeding behaviour) were examined at a fine-scale over a period of two years. Two hypotheses were tested: (1) The presence of macroalgae deters birds from feeding; and (2) The presence of macroalgae negatively affects the feeding behaviour of birds.

Five different growth phases of macroalgae were identi-

fied: (1) Early re-establishment (January–February); (2) Late re-establishment (March–April); (3) Accelerated (May–June); (4) Peak (July–August); and (5) Declining (September–October). Studied mussel beds constituted mostly of bare mud with scattered macroalgal areas during the early and late re-establishment phases presenting minimal physical interference to bird feeding behaviour. A mosaic of patches of bare mud and macroalgal-covered areas, which increased habitat heterogeneity, occurred during the accelerated and declining phases causing substantial interference to birds' feeding. A uniform layer of macroalgal mat, about 0.5 cm thick and biomass density up to 2.6 kg FW.m<sup>-2</sup>, covered more than 75% of the mussel bed area studied during the peak phase causing maximal physical interference to birds' feeding.



The mussel population comprised mostly of smaller mussels 6–15 mm in length. About 86% of mussel biomass constituted the sizes favoured by eiders (6–40 mm) and only 56% of mussel biomass constituted the sizes favoured by oystercatchers (21–45 mm). The abundance of different length classes of mussels changed significantly over the two-year period with numerical and biomass density of mussels in the length range 6–15 mm increasing and those in the 16–35 mm length range decreasing. Density of mussels between macroalgal-free and macroalgal-covered areas varied significantly; 16–20 mm, 26–30 mm and 31–35 mm size-classes were high in macroalgal-free areas whilst the 36–40 mm size-class was high in macroalgal-covered areas. Peak numerical and biomass density of mussels coincided with the peak phase of macroalgal growth. Oystercatcher had a high energetic demand for mussels through the winter period, when the quantity and quality of food supply were relatively poor. In contrast, eider had a high energetic demand for mussels through the late spring and early summer period, when the quantity and quality of the food supply were relatively good.

The effect of macroalgae on the feeding distribution and behaviour of mussel-feeding birds was species-specific. The first hypothesis (that macroalgae deters birds from feeding) was supported only during the re-establishment phase and only for eider. In contrast, both species appeared to be attracted to macroalgal-covered areas during the late phase

of macroalgal growth; eider during the accelerated and declining phases and oystercatcher during the peak and declining phases. It was evident that the presence of macroalgae over mussel beds did not completely deter mussel-feeding birds from feeding.

The second hypothesis (that macroalgae negatively affects birds' feeding behaviour) was supported only during the re-establishment phase and only for eider. However, most eider foraging behaviour appeared to be positively affected by macroalgae during the late phases of macroalgal growth (accelerated, peak and declining) although the rate of energy intake could not be measured and it is possible that birds were feeding on very small, unprofitable mussels during this period. Gross differences in feeding behaviour observed did not provide evidence of any effect of macroalgae on oystercatcher feeding. However, there was a significant decreasing trend in density of mussels of the size-classes mostly preferred by oystercatcher (21–45 mm) over the period of the study. Continued research is required to monitor whether or not this trend continues and to determine if the seasonal occurrence of macroalgae causes a direct or indirect increase in mussel mortality.

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#### **Parental behavior and the question of brood division in Whimbrels (*Numenius phaeopus*)**

(1997, M.Sc. thesis, University of San Diego, California, USA)

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Brood division in birds is defined as splitting of the family into two stable units in which one adult cares *exclusively* and *permanently* for one or more young until they become independent. I studied post-hatch behavior in Whimbrels to test for the occurrence of brood division, which had been reported previously. Ten breeding pairs in which at least one member was color-banded and fitted with a radio transmitter were followed during the 1995 breeding season in Churchill, Manitoba. I documented parental roles throughout the incubation period by direct observation and by time

lapse video camera. Additional observations in 1994, not supported by telemetry, were also used for analysis. In all cases, parents alternated incubation duties about equally during the day, but only the female incubated at night. In the post-hatch period, there was no evidence of brood division. Females were found to abandon broods as young as three days old, leaving parental care to males. Cases of brood division in birds are poorly documented, and for most species data supporting this behavior are unconvincing.

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#### **Cold winters vs long journeys: adaptations of primary moult and body mass to migration and wintering in the Grey Plover *Pluvialis squatarola***

(2002, Ph.D. thesis, University of Cape Town, South Africa)

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The aim of this thesis was to describe the primary moult of Eurasian Grey Plovers spending the non-breeding season at sites widely scattered across the non-breeding range. As in most moult studies, it mainly focused on the moult of primary feathers because this can be considered representative of the whole process under physiological, ecological and evolutionary perspectives. The Underhill-Zucchini model

was applied to the data in order to have comparable results. This allowed me to investigate the role of distance from breeding grounds and local climatic conditions on moult patterns. The Underhill-Zucchini model was also used, for the first time, to calculate moult parameters of single primaries, offering new insights of the process. Further analyses characterised morphometrically the various populations and



the respective age/sex groups, and described the seasonal variation of body mass.

Ringed data originating from seven wintering sites (Great Britain, Italy, Kenya, South Africa, India, NW Australia and SE Australia) were analysed. No field work was organised and carried out specifically to catch Grey Plovers for this study, except for some trapping sessions in Italy and South Africa; data-sets were gathered from ringing schemes, ringing groups or single ringers who had collected the data over many years of wader ringing. The overall dataset has been collected over the last forty years, from the beginning of pioneer wader ringing to the present time. Basic techniques of biometrics and moult data collection were already standardised in the late 1960s and this allowed data to be pooled and compared across various temporal and/or geographical grids.

Standard morphometric analyses showed that it is not possible in this species to determine the breeding origin of the populations on the basis of some standard measurements and statistical parametric analyses. The application of a POSCON discriminant analysis also failed to predict the breeding origins of birds.

Populations wintering in temperate regions (the Wash, England, and north-eastern Italy) had a clear mid-winter peak of body mass, interpreted as an insurance against the effects of severe weather: birds accumulated energy stores for periods of unpredictable feeding conditions. Southern populations (Kenya, South Africa, India, NW Australia, SE Australia) did not show any seasonal variation in body mass until the respective pre-migratory periods, when fuel stores for a long non-stop flight were deposited. Pre-breeding mass increase was temporally segregated from primary moult, while there was a partial overlap of these two metabolic processes during post-breeding migration. Pre-breeding partial moult started only when primary moult was completed and was compatible with mass gain.

The analysis of primary moult of the various populations showed that there were clear differences in moult durations: slow moults (121–131 days) in areas with mild winters and fast moults (90–93 days) in areas with cold winters. Latitude was taken as an index of weather conditions during the non-breeding period, being negative latitude values for the southern hemisphere linked to the austral summer and positive

values for the northern hemisphere linked to the boreal winter. No correlation between latitude and duration of moult was found, while mean starting date of primary moult was correlated to migration distance. This suggested that birds had an optimal moult duration south of 20°N and migrated at about the same speed along the various routes.

Grey Plovers regulated primary moult speed by varying both the number of simultaneously growing feathers and growth rates. Primary growth rate did not change in slow-moulting birds, while there was an acceleration throughout the whole moult period in fast-moulting birds. This acceleration was interpreted as a response to signals of winter arrival. Feather mass production was not constant throughout the moult period, as it was previously hypothesised, but increased in both groups between P1 and P5. In fast moulting birds mass production increased till P10, while it was constant between P6 and P10 in slow moulting birds, i.e. when 72% of total primary mass is produced. The outermost primary, P10, had a heavier and possibly more resistant structure than the inner primaries, possibly because it forms the leading edge of the wing and must therefore accomplish different aerodynamic functions with respect to other primaries. The hypothesis of structural differences between primaries suggested the existence of species-specific relationships, linked to wing shape and flight characteristics.

A comparison of primary moult durations and primary abrasions suggested that moult duration plays a key-role in determining primary resistance to wear, and hence primary quality. Long moults produce more durable primaries, possibly because they allow the inclusion of higher concentrations of melanins in feather keratins. It is also suggested that primary moult duration and feather quality might contribute to explain why the barycentre of the Grey Plover distribution in the Afro-Palaearctic migratory system is around the inter-tropical zone. This would be the closest area to the breeding grounds where birds can find optimal moult conditions.

Data presented in this study suggested that primary moult patterns observed in Europe should be considered as individual adjustments to a moult programme developed at tropical or subtropical latitudes. The Grey Plover therefore seems to be a 'tropical' wintering wader that has recently colonised temperate areas.

