

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.

Ecological factors underlying the nonbreeding distribution of Western Sandpipers

(2003, Ph.D. thesis, Simon Fraser University, British Columbia, Canada)

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Avian species in which males and females migrate to different nonbreeding areas provide candidate systems to study ecological factors underlying distribution patterns. Western Sandpipers (*Calidris mauri*) are such 'differential migrants'. They breed mainly in Alaska and overwinter along the American Pacific and Caribbean coastlines. In this thesis, I document an increasing proportion of females at more southerly latitudes. I review existing explanatory hypotheses for differential migration, propose two novel hypotheses, and test these with data collected at four latitudes.

According to the predation danger hypothesis, predator escape ability of males and females, indexed by wingloading, differs consistently across latitudes. Escape ability is generally reduced with higher wingloading. Individuals with poorer escape ability were therefore predicted to prefer southern sites, where less fat is required as insurance against environmental variability. Wingloading was higher overall for females. At one site I compared the sex ratio of carcasses, assessed molecularly, to that of free-living birds, but found no evidence for any sex-bias in predator-induced mortality. Wingloading increased with latitude in both sexes, but an index of predation danger remained constant across latitudes.

Within latitudes, wingloading was lower at smaller, and presumably more dangerous, sites.

According to the feeding niche hypothesis, intertidal invertebrates are buried more deeply towards the south, possibly due to higher ambient temperature and/or desiccation. Longer bills enable probing (foraging on buried prey) to greater depths. Females have disproportionately long bills, and can therefore exploit a feeding niche at greater vertical depth. Bill length residuals, corrected for tarsus length, were predicted to increase towards the south. This was only found in males. No clear change of feeding mode with latitude was detected. Females probed more than males at all locations, even though aspects of the ultrastructure of female bills did not indicate greater specialisation for probing. At the one site where the relationship was measured, both sexes probed more with increasing sediment temperature.

My results provide evidence for both hypotheses, while other hypotheses for differential migration were not supported. I suggest that both escape performance and feeding niche divergence are important factors in determining large-scale spatial distribution in Western Sandpipers.

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Patterns of predation on ground nesting meadow birds

(2002, Ph.D. thesis, The Royal Veterinarian and Agricultural University, Copenhagen, Denmark)

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This thesis deals with patterns of predation on nests of meadow birds with the primary aim of identifying the predatory species. The focus is mainly on lapwing (*Vanellus vanellus*), the most predominant breeding wader in the area. Other breeding wader species include oystercatcher (*Haematopus ostralegus*) and redshank (*Tringa totanus*).

The background for the project is the nature management effort (grazing steers, mechanical removal of shrubs and winter flooding) conducted in the Klydesø reserve on the island of Amager, near Copenhagen, Denmark. The management is a success in terms of increasing breeding densities of lapwing in the grazed areas but preliminary results also revealed a very high predation rate on lapwing nests. The event of actual predation was rarely observed and the identity of the predator(s) remained unknown as the majority of the predated nests were left empty with no visible signs of the predatory species.

Hooded crow (*Corvus corone cornix*) was initially regarded as the most likely nest predator. This species was abundant in the areas used by the breeding waders, and hooded crows were breeding in trees nearby. Remains of

wader eggs in shell dumps near crow nests also pointed towards hooded crow as the main predator. However, other potential predators were also present in the area, such as magpie (*Pica pica*) and red fox (*Vulpes vulpes*).

To reveal home range and behaviour of hooded crows in or near wader breeding areas several breeding hooded crows were trapped and fitted with a radio transmitter. The disturbance from the trapping activities, however, turned out to have a severe impact on crow behaviour: they gave up breeding activities and abandoned their territories. A high density of breeding hooded crows and the associated high risk of conspecific predation is suggested as the cause for the observed effect.

A considerable number of surveillance hours confirmed the presence of numerous hooded crows throughout daylight. However, numbers were low in the hour before sunset as well as the hour after sunrise. The most frequently observed behaviour of the crows was foraging on the ground, but also resting on the ground, whereas flying and resting in trees etc. was of minor importance. However, still not a single obser-



vation of predation of wader nests was made. On the other hand, crow predation on artificial nests (quail eggs), was often observed, indicating an ability by hooded crows to find and utilise an abundant food resource efficiently. Artificial nests were also used to reveal behavioural differences between hooded crow and magpie. After exposure of artificial nests numbers of hooded crows increased but no such reaction was seen by magpies. On the other hand, magpies may respond negatively to crow activity rather than to the exposure of artificial nests as numbers were lower when numbers of hooded crows were high.

Simultaneously, temperatures in lapwing nests were monitored to reveal the exact time of predation. A small thermistor probe was carefully placed beneath the eggs and connected with a thin wire to a time temperature data logger, which would register the temperature readings every three or six minutes. Wire and logger were hidden beneath the grass turf and were recollected after breeding activities had ceased. There was no difference in hatching success or predation rates between nests with or without instalment of the data logger, so the instalment did not bias the results by e.g. leaving cues to attract predators. Therefore, a logger is a convenient method to elucidate patterns of nest predation.

The results were convincing: more than 80% of all predated nests were lost at night. As the hooded crow is a diurnal bird the probability of crow predation on wader nests is therefore negligible, and focus changed towards the most predominant nocturnal nest predator in the area, the red fox.

To reveal the impact of fox predation on lapwing nests three replicates of fenced and non-fenced pens were established. Each pen covered c.9 ha. and the fenced ones were enclosed by poles with 6 or 7 electric wires. Nests established inside the fenced pens demonstrated a much higher hatching success as c.42% hatched successfully while only c.10% succeeded the non-fenced pens. This difference is most likely due to less fox activity in the fenced pens although the fences could not prevent other potential nest predators from entering the pens. However, the exclusion of foxes was only partial as the remaining 58% of the nests in fenced pens were predated with the same nocturnal pattern as for nests in the non-fenced pens. This illustrates that the pens were not effectively fenced. Only few indications of a compensatory avian predation were observed in the partial absence of foxes.

Because of the above mentioned results the focus of the project changed, during the five seasons of fieldwork, from avian/crow predation to mammalian/nocturnal predation. The nocturnal predation happened despite the fact that large numbers of hooded crows were present during daylight. Therefore anecdotes that hooded crows are severe predators on the nests of ground breeding birds could be rejected for this study site. Hooded crows, however, did predate nests but this impact was completely overruled by the incidence of nocturnal predation. Presumably this predation was carried out the red fox, although no direct observations of predation by this species were made.

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Born to fly: Migratory strategies and stopover ecology in the European Wadden Sea of a long-distance migrant, the Bar-tailed Godwit (*Limosa lapponica*)
(2003, Ph.D. thesis, Carl von Ossietzky University, Oldenburg, Germany)

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Migratory birds have to take several life history decisions during the annual cycle. Among others, they have to find a migratory strategy connected to stopover and wintering sites which allows the maximization of lifetime reproductive success. Depending on the migratory strategy followed, birds have different demands concerning a stopover site. The leap-frog migration system found in Bar-tailed Godwits offers an excellent study system to investigate the constraints and choices acting on different migratory strategies within one species. In the European Wadden Sea, the Afro-Siberian population stops over on migration between African wintering and Siberian breeding areas. For the European population, the Wadden Sea acts either as a stopover site between Western European wintering and Scandinavian breeding areas or as a wintering area. In the Sylt-Rømø Wadden Sea, located in the northern part of the European Wadden Sea, the consequences of different migratory strategies on stopover ecology, as well as interactions with soft sediment intertidal systems were investigated.

Although more than 10–12 million waterbirds spend at least a part of their life cycle in the Wadden Sea, their general impact on the benthic community is small in terms of biomass consumption. As in other temperate intertidal areas, carnivorous birds in the Wadden Sea consume 10–25% of the annual secondary production. For the Sylt-Rømø

Wadden Sea, annual consumption of intertidal secondary production was estimated at 8.7 g AFDM m⁻², which should be representative for the entire Wadden Sea in the 1990s. In a small, adjacent bay to the Sylt-Rømø Wadden Sea, the Königshafen; mean annual consumption by carnivorous birds was elevated due to an elongated tideline in the bay in relation to intertidal area. Consumption was dominated by the Common Eider with 37 and 60% of the total consumption, respectively. Because of the high proportion of sandy intertidal area, Bar-tailed Godwits took an 11% share of the total consumption by birds in the Königshafen as opposed to 3% in the entire Sylt-Rømø Wadden Sea.

Bar-tailed Godwits occurring in the Königshafen belong to the European population as morphometric and ringing data confirmed. In contrast to Afro-Siberian Bar-tailed Godwits which stopover for approximately one month in the Wadden Sea, individually marked birds in the Königshafen stayed for 30–40 days in spring. Furthermore, between years Bar-tailed Godwits turned out to be highly site-faithful. Moulting from winter into breeding plumage took 43 days in spring and moulting from ¾ breeding plumage back to winter plumage took 28 days. Sex ratio was always 1:1 apart from late May and winter. In winter, the smaller males left for milder areas in the western Wadden Sea and Great Britain. Even when assuming 100% site faithfulness, annual mortal-



ity rates for adult birds were as low as 17–26 %.

Diet of Bar-tailed Godwits in the Königshafen area was estimated by a combination of faecal analysis and visual observations. Overall, 17 prey species were found in droppings but only four polychaetes, *Arenicola marina*, *Nereis diversicolor*, *Nephtys hombergii*, *Scoloplos armiger*, and one crustacean, *Carcinus maenas*, were taken regularly. The diet showed strong seasonal variations, as well as differences between the sexes which were more pronounced in spring and summer than in winter when small and easily accessible polychaetes dominated the diet.

The seasonal phenology of birds wintering in the Wadden Sea must depend on local conditions. An energy budget was used to investigate whether the European population of Bar-tailed Godwits is constrained by energy intake on spring migration and to what extent thermostatic costs influence winter distribution in Europe. The seasonal pattern of energy intake and basic energetic costs (without e.g. activity costs) were closely correlated. During spring migration, birds regulated energy intake to a low level by reducing foraging time as soon as intake rates increased. Therefore, a much higher

energy gain should have been possible. The low body mass increase was interpreted as a part of an energy minimizing migratory strategy. During winter, thermostatic costs in the northern Wadden Sea increased to 2.4 and 2.9 × BMR for females and males, respectively. Males left the area earlier than females as a consequence of higher thermostatic costs. Although the relation between thermostatic costs and energy intake is much better in the main wintering areas, some birds take the choice of wintering as far north as possible.

Migration can be optimized by minimizing time, energy expenditure or predation risk. Behaviour of the two Bar-tailed Godwit populations occurring in the Wadden Sea indicated that birds from the European population followed an energy minimizing migratory strategy whereas birds from the Afro-Siberian population followed a time minimizing strategy with much higher energy demands. The latter birds achieved the higher energy intake in relation to European birds by an elongation of foraging time, by starting moult into breeding plumage in the wintering quarters and by arriving in the Wadden Sea at times with lower thermostatic costs.

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Factors affecting the distribution, abundance and chick survival of the Lapwing (*Vanellus vanellus*)
(2003, Ph.D. thesis, Harper Adams University College, Shropshire, UK)

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The aim of this thesis was to investigate Lapwing *Vanellus vanellus* breeding ecology and its relationship with the modern agricultural landscape; research having suggested that changes in agricultural practices have been responsible for population declines in a suite of farmland bird species, including the Lapwing.

Fieldwork was conducted during the breeding seasons of 1999 and 2000 over a range of farm locations in Shropshire and Staffordshire in the UK, with additional supplementary data obtained from a parallel study undertaken in Cambridgeshire. This research assessed the effectiveness of the 'Lapwing Option' (Option 1B) in the pilot Arable Stewardship agri-environment scheme.

A total of 225 nests were located and monitored. There were few detectable effects of agricultural variables on clutch size, egg volume, intra-clutch egg size variation or hatching rates. Cultivation dates stipulated by Option 1B avoided the peak nesting period for this population of Lapwings. At the start of the breeding season Lapwings selected a wide variety of crop types as nest sites, however, crop choice declined as the season progressed, with the majority of replacement nests on Option 1B and spring crops. Lapwings were shown to select nest sites that had a short, patchy sward structure. Nest survival was high, yet the most common causes of nest failure were predation and losses to agricultural operations.

Losses on stubbles and spring cereals were primarily associated with agricultural operations. Nests that were greater than 50 m distant from a field boundary had a greater probability of survival than nests that were less than 50 m away. Chick weight and condition were shown to be positively correlated with mean egg volume. There was no evidence that any of the measured agricultural variables had an effect on chick growth, condition or survival. Results show that chick survival was low and productivity estimates were less than that required to maintain population stability. Chicks that were known to have fledged had a better body condition index than chicks that had been predated. It was found that the variety of crop types used as foraging habitat declined as the season progressed. Option 1B, set-aside and sugar beet were the latest crops that could be utilised by chicks. A variety of invertebrate taxa were found in faecal samples of chicks, with earthworms, beetles and spiders the most frequent. There was a positive relationship between the number of earthworms in the diet and chick age, chick condition and daily growth rates.

Option 1B appears to have a number of benefits for breeding lapwings, although it does not address low chick survival. Further research is required to elucidate the key factors affecting chick survival and to develop management prescriptions to enhance breeding productivity.

Jannik Hansen whose M.Sc. thesis abstract (on **Male territoriality and female brood desertion in Purple Sandpipers**) was published on page 52 of Volume 101/102 of the *Wader Study Group Bulletin* has written to say that his e-mail address has changed to jannikh@jannikh.dk

