

Abstracts of Wader Theses

compiled by ROB ROBINSON

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).

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Ecological research on Dunlin *Calidris alpina* at Chongming Dongtan, China

(2009, M.Sc., Fudan University, Shanghai, China)

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The Dunlin *Calidris alpina* is one of the most common shorebird species along the East Asian–Australasian Flyway (EAAF). Ten subspecies have been identified globally, and at least four of them occur along the EAAF. Chongming Dongtan (CMDT) is on the Yangtze River estuary, China, and in the middle of the EAAF. CMDT also plays an important role as a stopover and wintering site for migratory shorebirds. The number of Dunlins found at CMDT exceeds 1% of the total Dunlin population of the EAAF and therefore the site is of significance for Dunlin conservation, and provides an ideal site for research on the stopover and wintering ecology of this species.

This thesis describes age-determination of Dunlin along the EAAF and evaluates the reliability of different plumage characters in age identification. Age-related variations in migration timing, body condition (adjusted body mass according to body size) and moult were also investigated. Moreover, the difference in body condition between Dunlins and other calidrid sandpipers (Great Knots *C. tenuirostris*, Red Knots *C. canutus*, Red-necked Stints *C. ruficollis* and Long-toed Stints *C. subminuta*) were compared with the aim of understanding the relationship between migration strategies and body condition. The main conclusions were as follows:

1. An effective age determination method was developed after comparing Dunlin samples from breeding grounds in Alaska and several wintering grounds in mainland China and Taiwan China. The pattern of white on the tip of the primary coverts proved to be an important ageing criterion for Dunlin along the EAAF. About 90% of first-year Dunlins had a symmetrical white tip on their primary coverts, while the white tip of 73%–89% of adult Dunlins was either step-like or droplet-like. In addition, most first-year Dunlins had a continuous buff edge to their median coverts, and some tertials or tertial coverts, or inner median coverts were marked with a dark subterminal band. The usefulness of different ageing criteria varied with location and season, this especially being the case for the “adult-buff” coverts, which might be present in only some Dunlin subspecies of the EAAF. Ageing criteria are limited by several factors, such as moult, feather abrasion and bleaching; therefore the best basis for ageing Dunlin in the EAAF is to use a combination of several plumage characters.

2. A study of migration phenology and body condition between different age-groups of Dunlins showed that body conditions were the lowest after southward migration. These remained stable throughout the winter period, reaching peaks before northward migration. The body conditions of first-year

Dunlins were significantly lower than those of adults just before northward migration (May) and after southward migration (Sep–Oct). More than half of the early-returning adults were second-year birds, many of them may be failed breeders or not performing a complete migration. The age-structure of Dunlins at CMDT during migration and during winter were dominated by first-year birds (63–95%), significantly higher than those in other parts of China (e.g. 32.1% in Tangshan, Hebei and 17.6% in Putian, Fujian) in January.

3. At CMDT, the body condition of Dunlins in active body moult was significantly higher than those which had not started or had suspended body moult, but those that had completed body moult tended to have higher body condition. These results suggest that body moult has an impact on body condition and the deposition of reserves. Comparing arrival times of different age-groups in Europe, America and CMDT during southward migration suggests that there is a close link between the timing of primary moult and the sequence of arrival on the wintering grounds. Among the subspecies in which the adults moult their primaries on the breeding grounds, the juveniles arrive simultaneously with or even earlier than the adults. Among those which carry out primary moult during a southward migration stopover or on the wintering grounds, the adults often arrive at stopover sites and wintering grounds in advance of the juveniles.

4. Comparison of body condition and fuel deposition patterns in Dunlins and four other calidrid sandpipers at CMDT indicate that these factors vary between seasons and between age groups within each species. Moreover they differed between species that employ different migration strategies. Dunlins that winter at CMDT showed significantly higher body condition during the onset of northward migration in spring than after arrival in autumn, most likely reflecting the laying down of reserves for the long migration to the breeding grounds. In contrast, Great Knots and Red Knots perform a long-distance nonstop flight from CMDT to NW Australia in autumn, while covering a relatively short distance between CMDT and the north Yellow Sea region in spring. Consequently significantly higher body conditions were recorded for both species at CMDT in autumn than in spring. However, they also showed a significant increase in body condition during northward migration, which might reflect the replacement of reserves after the long flight from Australia. In contrast, Red-necked Stints and Long-toed Stints, which migrate in a series of relatively short flights, showed no significant difference in departure body condition at CMDT between

seasons, nor did the adults show any significant increase in body condition during northward or southward stopover. On the other hand, first-year birds of all five species showed a significant increase in body condition during southward migration stopover, indicating a significant role of CMDT in

the fuel deposition of first-year sandpipers. When considering the value of a particular stopover site for any species, the emphasis should not be exclusively on abundance; the role played in fuel deposition for different age-groups and in different seasons is also of importance.

**Abundance, distribution and feeding ecology of shorebirds
(Charadriiformes: Charadrii and Scolopaci) in the coastal zone of Rio Grande do Sul, Brazil**

**(Distribuição, abundância e ecologia alimentar de aves limícolas
(Charadriiformes: Charadrii e Scolopaci) na zona costeira do Rio Grande do Sul, Brasil)**

(2008, Ph.D., Universidade Federal do Rio Grande, Brazil)

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I carried out studies on the distribution, seasonal abundance and feeding ecology of shorebirds (waders) along the coast of the state of Rio Grande do Sul (RS) in southernmost Brazil. The study was divided into three chapters, as follows:

During April–May 2005, ground censuses of shorebirds were conducted in the lagoon areas of the Lagoa do Peixe National Park (34 km²) and along 350 km of the sandy beaches of RS (53% of the entire coast of the state, including portions with very low human occupation). I recorded both Nearctic birds heading northward and Neotropical birds in their post-breeding period. The Neotropical shorebirds included both residents that breed in the dune areas or inland ecosystems of RS as well as austral migrants that breed in southern South America. In April, 26,000 shorebirds of 15 species were recorded, 92% of which were Nearctic migrants, with a predominance of Red Knots *Calidris canutus* (8,000 in sandy beaches and lagoon environments), Sanderlings *C. alba* (7,000 on the beaches) and White-rumped Sandpipers *C. fuscicollis* (8,000, mainly in lagoon environments). Other Nearctic migrants recorded in hundreds were Black-bellied Plovers *Pluvialis squatarola*, Semipalmated Plovers *Charadrius semipalmatus* and Hudsonian Godwits *Limosa haemastica*. In May, just over 11,000 shorebirds of 17 species were recorded (72% Nearctic migrants). The most abundant resident species was American Oystercatcher *Haematopus palliatus* (average density = 3.5 birds per km of shore, about 1,600 in each month). The austral migrants Two-banded Plover *Charadrius falklandicus* and Rufous-chested Dotterel *Charadrius modestus* were only recorded in lagoon environments and with maximum numbers in May (160 both combined). More species and greater densities were recorded in lagoon environments, although the birds were also distributed among all the stretches of the coast and at densities as high as 50 per km. This demonstrates the importance of the RS coast for these birds. In comparison with data for the same sites in the 1980s, there appears to have been a fall in the abundance of the dominant species, at least in respect of Nearctic migrants, as well as a reduction in the number of species along the coast of southern RS.

The second phase of the study focused on Nearctic migrants in the Lagoa do Peixe National Park during the austral summer. The aim was to identify shorebird food resources in beach and lagoon environments and relate the abundance of birds to that of their prey. Shorebird censuses were carried out

between Oct 2005 and May 2006 in lagoon areas (the sandbar region of Lagoa do Peixe; 3 km²) and along 18 km of sandy beaches. Twenty four samples of benthic macro-invertebrates were also collected every month in both environments to determine the nature and abundance of potential prey. To determine the prey consumed by the most abundant shorebirds (Red Knot, Sanderling and White-rumped Sandpiper), faeces and pellets from each species were collected in both environments. These were analysed and prey identified from residual body parts. Sanderlings and White-rumped Sandpipers were very abundant throughout the study period, with peak numbers during southward migration (White-rumped Sandpiper: c. 15,000 in the lagoon in Nov; Sanderling: c. 7,000 on the beach in Dec), but Red Knots were more abundant during northward migration (c. 800 in the lagoon in April). The main prey items consumed by shorebirds on the beach were Mole Crabs *Emerita brasiliensis* and young of the bivalves *Donax hanleyanus* and *Mesodesma mactroides*. In the lagoon, the main preys were the nereidid polychaete *Laeonereis acuta* and the gastropod *Heleobia australis*. The greatest invertebrate densities were related to the greatest numbers of Sanderlings and White-rumped Sandpipers in the environments in which they occurred. Beetles were also an important prey. White-rumped Sandpipers preyed upon a great variety of organisms, but Sanderlings were more selective, feeding preferentially on crustaceans.

The third phase of the study investigated the diet and foraging strategy of American Oystercatchers *Haematopus palliatus* along the coast (18 km) and in lagoon areas (3 km²) of Lagoa do Peixe between Oct 2005 and May 2006 through foraging observations and analysis of prey leftovers and faeces. Generally American Oystercatchers consumed the larger invertebrate prey available in abundance in both environments (lagoon and beach). Preferential prey were bivalves (three species) and crustaceans (six species), but American Oystercatchers also took smaller organisms that were available in these locations, such as beetles and other insects, polychaetes and small bony fish. They employed different techniques to handle each prey species, some not described in the literature. These included the extraction of the soft parts of the Yellow clam *Mesodesma mactroides* without removing the shell from the sand and ingesting only the abdomen of egg-carrying Mole Crabs.

Trophic ecology of Red Knot (*Calidris canutus rufa*), White-rumped Sandpiper (*Calidris fuscicollis*) and Sanderling (*Calidris alba*) at Península Valdés

Ecología trófica del Playero Rojizo (*Calidris canutus rufa*), playero de Rabadilla Blanca (*Calidris fuscicollis*) y playero Blanco (*Calidris alba*) en Península Valdés

(2007, Ph.D., Universidad Nacional del Comahue, Argentina)

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Three species of shorebirds occur regularly at Península Valdés, Argentina: Red Knot *Calidris canutus rufa*, White-rumped Sandpiper *C. fuscicollis*, and Sanderling *C. alba*. Based on four years study, 2002 was a year with low numbers of shorebirds, in 2003 and 2005 abundances were intermediate, and in 2004 they were high. Different reasons might account for these variations. They could be due to varying food supply or to total population change, such as the decline in the flyway population of Red Knots.

At Fracasso Beach, there is a significant correlation during Mar–Apr between the presence of shorebirds and the biomass of the clam *Darina solenoides*. Therefore the occurrence of shorebirds at this site must depend largely on the food supply available. Analysis of weekly counts at Fracasso Beach during Mar–Apr of 1994–2005 shows that there has been some variation in the phenology of the migration of Red Knots. Generally, from 1994 to 1999 Red Knots occurred during both March and April, but in 2000 practically none arrived in March. Moreover in 2004 and 2005 the first Red Knots were not recorded until May. It is very likely that this delayed stop-over at Península Valdés will have been reflected in similar changes at other sites along the West Atlantic Flyway.

In the beaches with sandy substrates, two clam species are prominent: *D. solenoides* and *Tellina petitiana*. The first is dominant in the middle and higher levels of the intertidal zone, and the second is found in the lower levels. However, at Punta Norte, mytilidae are the dominant bivalves. Comparing the different sandy beaches from the San José

Gulf along the coast from east to west (Riacho, Punta Gales, Isla de los Pájaros, Fracasso and San Román), *D. solenoides* gradually increases in abundance and distribution as far as Fracasso beach where it reaches its maximum; then, at San Román Beach it decreases to its minimum. At Riacho beach, it is found in the middle of the intertidal zone; and at Punta Gales, it is found in the higher levels of the zone. Therefore, Fracasso Beach is the place where this clam is exposed by the tide for the longest time and is most readily available to be consumed by shorebirds. The population of *D. solenoides* at Fracasso Beach is different to that of the nearby sites in that it has a greater spatial distribution and occurs at greater densities. These characteristics must be the main reason why the shorebirds use this beach as their preferred foraging site.

Sanderlings are the only shorebirds found at Punta Norte, whereas all three species are found at Colombo Beach, but only Red Knots and White-rumped Sandpipers occur at Fracasso Beach. The diet of the Sanderling includes the same taxonomic groups mentioned in the literature for other sites: crustaceans, annelids, molluscs and insects. At Punta Norte, where there are rocky shores, their diet consists of isopods (*Exosphaeroma* sp); however, at Colombo Beach with a sandy substrate, they eat clams (*D. solenoides*) and the polychaete *Travisia olens*. Worldwide Red Knots generally feed on hard-shelled bivalves such as *Macoma balthica*, *Brachidontes rodriguezii*, *Darina solenoides* and *Tellina petitiana*. At Península Valdés, they feed on *D. solenoides* and *T. petitiana*. White-rumped Sandpipers have a varied diet, taking both invertebrates and seeds depending what is available. Our results show that the preferred prey of this species on sandy beaches is the clam *D. solenoides* and the polychaete *T. olens*. When the densities of invertebrates are low, seeds and insects become their occasional food.

One aim of this study was to determine whether the energy content of the invertebrate prey is at a maximum at the time of the shorebird stopover at Península Valdés. It also seemed possible that prey selection could be influenced by the fact that *D. solenoides* has greater energy content than the other preys found in the intertidal areas of the beaches. The choice of foraging site could be due to the high densities and spatial distribution of this species. The timing of the stopover in Mar–Apr could be related to the period in which the clams reach peak condition and have the highest percentages of lipids and proteins.

The daily energy intake of Red Knots at Colombo Beach was estimated at 249.8 kJ and at Fracasso Beach, it was 401.4 kJ. For White-rumped Sandpipers it was 48.5 kJ at Colombo beach, and 68.9 kJ at Fracasso Beach. For Sanderlings it was 38.8 kJ at Punta Norte, and 115.2 kJ at Colombo beach. The shorebirds on the coast of Península Valdés generally feed on the clam *D. solenoides*. Nevertheless, at Colombo Beach, Fracasso Beach and Punta Norte they also feed on secondary prey not included in the estimation. The figures mentioned above are likely to be underestimates, partly because they do not include these secondary prey items and partly because they do not take account of any night-feeding.

Cross-seasonal factors affecting breeding investment by female Pacific Dunlins

(2009, Ph.D., Simon Fraser University, Burnaby BC, Canada)

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Myers proposed the Migration Distance Hypothesis (that the costs of long-distance migration force a compensating reduction in breeding investment) to explain parental care differences between species and sexes in shorebirds. This thesis proposes that seasonally increasing predation danger during migration is the main cost of extending breeding investment, and examines whether danger and other cross-seasonal factors predict reproductive patterns of Pacific Dunlins *Calidris alpina pacifica* and other shorebird species breeding in Alaska. The Predation Danger Hypothesis assumes that moult and migration schedules of shorebirds evolved to minimize exposure to raptors, especially migratory Peregrine Falcons *Falco peregrinus*. The hypothesis predicts that these scheduling considerations affect parental care because they either require shorebirds to depart breeding areas early and in advance of falcon migration and moult on non-breeding areas prior to the migratory arrival of falcons; or to remain on or near northern breeding areas to moult, and migrate after falcon passage.

Following breeding, Pacific Dunlins linger in Alaska until October, arriving on wintering areas after peak falcon passage. I found that breeding Pacific Dunlins renested and

double-brooded extensively. Female Pacific Dunlins invested more time to reproduction and remained longer on the breeding grounds than female Western Sandpipers *Calidris mauri*, their sympatrically-breeding, ecologically-similar, and early-migrating congener. The breeding seasons of both species were initiated on almost the same day, but the breeding investment of female Pacific Dunlins exceeded that of female Western Sandpipers by 7.2 days, and the seasonal decline in parental care duration of Western Sandpipers was steeper than in Pacific Dunlins. As predicted, Western Sandpipers but not Pacific Dunlins departed sooner in years with early falcon southward migration (related to snowmelt timing), and they gave up more breeding opportunity to do so.

Stable isotope analyses showed that Dunlins and other sandpipers are primarily income rather than capital breeders and I found little support for the Differential Parental Capacity Hypothesis (that female shorebirds truncate care due to higher investment in egg production). These findings support the Predation Danger Hypothesis and highlight how predation danger can have far-reaching impacts on the life histories of potential prey species.

Prey availability and quality and the foraging behaviour of the Red knot *Calidris canutus rufa* in its main wintering area, Bahía Lomas, Tierra del Fuego (Chile)

(Disponibilidad, calidad de presas y conducta d forrajeo para el Playero ártico *Calidris canutus rufa* en su principal área de invernada, Bahía Lomas, Tierra del Fuego (Chile))

(2008, B.Sc., Universidad Santo Tomás, Santiago de Chile)

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Bird migration represents one of the biggest ecological challenges known among animals, considering the energetic cost and uncertainty about the presence of food resources along the migration route. The Red Knot *Calidris canutus rufa* is a shorebird that yearly migrates from the Arctic to Bahía Lomas, Tierra del Fuego, Chile. This is the main wintering area of the species within South America, and important population declines have been observed during the last decade. The bay is characterized by a 7 km tidal flat with benthic bivalves and polychaete species, and an area with mussel beds. Therefore the Red Knots have the choice of foraging in different areas in which prey of different type and quality are available.

The aim of this work was to study the nutritional ecology of *C. c. rufa* on its main wintering area. The availability, intake rate, fatty acid concentration, energetic content and digestible mass of the main prey consumed by *C. c. rufa* were assessed. We also characterized the Red Knot's digestive tract. Results show significant differences between the main prey densities along the tidal flat (the highest bivalve density was found in the mid intertidal zone). Intake rate also showed significant differences between the two foraging sites (tidal flat versus mussel bed), indicating that the intake rate on the

mussel bed was higher.

The quality (in terms of fatty acid concentration and energetic content) of the main prey types consumed by Red Knots (the bivalves *Mytilus edulis chilensis* and *Darina solenoides*, and an unidentified species of polychaete) showed no significant differences. However, the bivalves differed in that the proportion of the mass of *Darina* that was digestible was greater than that of *Mytilus*. The size and mass of the digestive tract of *C. c. rufa* was similar to that of other Red Knot subspecies feeding on similar prey (mainly bivalves).

Our results show that the *C. c. rufa* that winter in Bahía Lomas have a choice of prey that varies in both quality and quantity. Due to their high digestive phenotypic plasticity, these shorebirds are able to feed profitably due to their capacity to find buried prey and the capacity of their digestive tracts to process and digest hard shelled prey and thereby obtain energy and nutrients from prey that are not available to other species. We conclude that *C. c. rufa* is capable of accumulating nutritional reserves (fats) from the available prey by switching between both sites (tidal flat and mussel bed) and prey types in order to fuel the beginning of their long migratory flight to the arctic breeding grounds.