

# 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).

Thesis authors are invited to submit abstracts to Rob Robinson, BTO, The Nunnery, Thetford, Norfolk IP24 2PU, UK. [rob.robinson@bto.org](mailto:rob.robinson@bto.org) or the Editor.

## **Bottlenecks, budgets and immunity: the costs and benefits of immune function over the annual cycle of Red Knots (*Calidris canutus*)**

(2008, Ph.D., University of Groningen, The Netherlands)

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The immune system is important for survival, but maintaining and using that system carries energetic and immunopathological costs. Because of this combination of importance and cost, trade-offs between immune function and other costly activities (i.e. thermoregulation, migration, reproduction) have been predicted over the annual cycle and during times of resource limitation. However, empirical data on variation in immune function under controlled conditions is lacking, as is information on when most wild species might be immunocompromised. My Ph.D. research bridges these gaps and addresses how animals allocate resources between competing physiological systems to maximize fitness. I had three goals: (1) Determining when in the annual cycle migrants face bottlenecks or “tough times”. (2) Determining annual variation in immune function under controlled conditions. (3) Experimentally testing the effects of various environmental factors on immune function.

To determine when in the annual cycle migrants face bottlenecks, I synthesized knowledge on Red Knot ecology and found that both resource and disease risk bottlenecks are most severe during spring migration. This highlights the complex nature of the optimization of immune function since both decreased immune function due to energetic trade-offs and increased immune function due to increased disease risk can be predicted from this result. To determine annual variation in immune function under controlled conditions I employed new techniques for measuring different aspects of immune function from blood samples (microbial killing ability, cellular immune potential, and complement, natural antibody and

haptoglobin levels). I also used multivariate statistical techniques to examine how different aspects of immune function group together into strategies and how these strategies change over the year. I took monthly measurements of baseline immune function and found that it varied significantly over the annual cycle, even in captive birds, and that higher cost immune strategies were important during migration, but were down regulated during peak feather moult. I also found that immune index scores were repeatable over the annual cycle and that covariation among indices suggests that birds use different “immune strategies” during different annual cycle stages. Finally, I experimentally manipulated various environmental factors and found that increased energy expenditure, decreased temperature and decreased energy availability did not affect baseline immune function, although aspects of induced immune function were affected by decreased food availability. Furthermore, variation in baseline immune function over the annual cycle did not correlate with fluctuations in photoperiod or melatonin exposure. Concurrently, I examined the effect of investigation artefacts (handling stress) on immune function, contrasted immune function in captive and free-living knots and examined immune function in free-living knots in terms of age and habitat quality.

Taken together my results establish that baseline immune function varies over the annual cycle, but that this variation is not driven by any of the factors I measured in captive birds. What then is driving this variation in immune function? An obvious answer is disease risk, and I hope to test this idea in the future.

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## **Population dynamics and habitat use of shorebirds at Ensenada de La Paz, Baja California Sur, Mexico as a component of the Pacific Flyway**

**(Dinámica poblacional y uso de hábitat de las aves playeras en la Ensenada de La Paz, como componente del corredor migratorio del Pacífico)**

(2007, Ph.D., Facultad de Ciencias Marinas, Universidad Autónoma de Baja California, Mexico)

**Roberto Carmona**

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I determined and evaluated the population dynamics and habitat use of the shorebird community at Ensenada de La Paz between 1996 and 2003. For this, I carried out counts, focal observations, captures with mist nets and re-observation of banded birds. On the basis of these activities:

1. I made a list of 36 shorebird species inhabiting the study area, ranking it in first place for species richness of shorebirds in the whole of Mexico; this is partly the result of the area’s environmental heterogeneity and partly a reflection of increased sampling effort.

2. I determined the spatial and temporal distribution of shorebirds in the coastal zones and in the nearby oxidation lagoons (artificial freshwater bodies).

3. I compared habitat use by shorebirds at both sites; the lagoons were used mainly in autumn, while the beach was used more frequently in winter and in early spring; therefore I suggest that the lagoons were used mainly by passage migrants. The results of this study led to the inclusion of Ensenada de La Paz in the Western Hemisphere Shorebird Reserve Network.

4. I determined the patterns of habitat use in both sites in relation to the tide level; for those species that used both places, the tide level was the determining factor of its level of use, particularly for Western Sandpiper *Calidris mauri*, the most numerous species.

5. Tide level also had a positive effect on rates of aggression of the Western Sandpiper in the oxidation lagoons.

6. I determined the composition by sex and age of the populations of Western Sandpipers and Least Sandpipers *C. minutilla* at both locations in winter. Adult Western Sandpipers were more abundant on the beach (80%) and juveniles on the lagoons (80%). This suggests that the adults exclude the juveniles from the beach. Least Sandpipers had lower rates of aggression than Western Sandpipers and did not show differences in sex-ratio between sites. Adult Least Sandpipers

were more abundant than juveniles in autumn (80%) than in winter (30%).

7. Analysis of the probability of capture of Western Sandpipers showed a low effect of sex but a high effect of age in that proportionately more juveniles were captured than adults. This bias might be explained on the basis that adults tend to move less between feeding areas.

8. A study of site fidelity in Western Sandpipers showed that birds banded in autumn had the lowest rates of return, indicating a greater proportion of birds in transit at this season. The median departure date of banded Western Sandpipers was 28 February and there was no significant difference between the sexes. This indicates that the separate migration phenology of males and females reported in the literature starts further north.

9. Counts showed lower numbers of shorebirds using Ensenada de La Paz in spring than in autumn. This might be the result of birds using different migration routes. Thus southbound flocks might split, one group following the mainland coast of Mexico (Sonora) and the other the Baja California peninsula where some may stay for the winter while others continue south flying along the coast of the Mexican mainland. In spring, the latter group may return along the mainland coast, avoiding the sea-crossing to the peninsula, thus completing an elliptical migration.

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### Mountain Plover abundance and nest survival in Northeastern Montana

(2006, M.S., Mississippi State University, United States)

**Theresa M. Childers**

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I estimated abundance of Mountain Plovers (*Charadrius montanus*) in three strata in north-central Montana. Most (N = 768, 95% CI = 668, 960) occurred on active Black-tailed Prairie Dog (*Cynomys ludovicianus*) colonies with fewer on a Bureau of Land Management Area of Critical Environmental Concern (N = 160, 95% CI = 100, 285) and in surrounding habitats (N = 85, 95% CI = 60, 119). I modeled Mountain Plover nest survival as a function of temporal patterns, weather, and habitat effects at 3 spatial scales. Incubation

period survival ranged from 0.54 to 0.68. Daily nest survival was a function of quadratic temporal variation within years, year, daily precipitation, landscape shrub and bare ground coverage, nest macrohabitat heterogeneity, and microhabitat bare ground patch density. These results provide the first abundance estimates for this region, identify important influences on nest survival, and provide a model to evaluate those effects and predict nest survival under differing conditions.

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### Nesting ecology of Snowy and Wilson's Plovers in the Lower Laguna Madre region of Texas

(2006, M.S., Mississippi State University, United States)

**Sharyn L. Hood**

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I studied breeding Snowy and Wilson's Plovers in the lower Laguna Madre region of Texas in 2003–04. I estimated the number of breeding adults within the study area at 416 Snowy Plovers (95% CI = 394, 438) and 279 Wilson's Plovers (95% CI = 262, 296). I also modeled the daily survival of nests of both species as a function of nest age, year, within-season temporal trends, maximum daily temperature, daily precipitation, and habitat features surrounding each nest at three spatial scales. Daily survival of Snowy Plover nests

was a function of location, time of season, daily age of the nest, the presence of an object near the nest, and the spatial heterogeneity of vegetation within 25 m of the nest. Nest survival of Wilson's Plovers was best explained by amount and spatial arrangement of vegetation at the immediate nest site. Collectively, this information will provide guidance for habitat management that will benefit these species of conservation concern.

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**Incubation behavior and dispersal patterns in the Mountain Plover (*Charadrius montanus*)***(2008, M.S., Iowa State University, United States)***Paul D.B. Skrade***skradepa@iastate.edu*

I examined the dispersal and incubation behavior of Mountain Plovers (*Charadrius montanus*) in Montana to expand on current knowledge of their life history. I used nest locations from a 13-year period (1995–2007) to examine patterns of sex bias, prior experience, and sylvatic plague in their dispersal. I found no sex-bias in natal dispersal or within-year breeding dispersal. Mean dispersal distance of male plovers in consecutive years was 2.75 km (95% CI 1.51 to 4.00) and for females was 4.64 km (95% CI 2.76 to 5.52). Birds that were successful moved 3.02 km (95% CI 1.87 to 4.17) on average between nesting attempts, while those whose nests had failed moved 5.06 km (95% CI 2.53 to 7.58). The best model of between-year breeding dispersal indicated that prior nest fate had the strongest effect. There was a year effect but no effect of sylvatic plague on dispersal. I explored sex, time of day, nest age, day of season, and year differences in breeding behavior by modeling the duration of departures of incubating adults. I recorded 857 hours of video of 24 incu-

bating Mountain Plovers during 2007 and >10,000 hours of temperature data from 117 individuals at 142 nests during the 2006–2008 nesting seasons. Video data revealed that males on average made 1.48 departures hour<sup>-1</sup> over the course of a 24-hour period (n = 6 deployments, SE = 0.35) and females made 1.41 departures hour<sup>-1</sup> (n = 26 deployments, SE = 0.11). From the combined video and temperature data males contributed 1,925 nocturnal departures with a mean duration of 0.38 hr (SE = 0.01) while females contributed 2,716 nocturnal departures with a mean duration of 0.36 hr (SE = 0.01). The quadratic effect of the time of departure was the most important factor in the length of nocturnal off-bouts; day of incubation and the day of the season were also important. Sex was not an important predictor of duration of departure. My study improves our knowledge of behavior in an uncommon mating system and provides insight into behaviors that might enable land managers to better address conservation issues facing this species.

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