Abstracts of wader theses

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

Aspects of habitat selection, population dynamics, and breeding biology in the endangered Chatham Island oystercatcher *Haematopus chathamensis*

(2001, PhD thesis, University of Lincoln, Canterbury, New Zealand)

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BACKGROUND

In the late 1980s the endangered Chatham Island oystercatcher *Haematopus chathamensis* (CIO) was estimated at less than 110 individuals. Endemic to the Chatham Islands, New Zealand, it was feared to be declining and, based on existing productivity estimates, in danger of extinction within 50–70 years. These declines were thought to be caused by numerous changes since the arrival of humans, including the introduction of several terrestrial predators, the establishment of marram grass *Ammophila arenaria* which changes dune profiles, and increased disturbance along the coastline. The New Zealand Department of Conservation has undertaken recovery planning and conservation management to increase CIO numbers since the late 1980s.

Recovery planning raised some key research questions concerning the population dynamics, habitat selection, and breeding biology of CIO, and the critical factors currently limiting the population. The objectives of this study were to collect and interpret data on: 1) population size, trends, and distribution across the Chathams, 2) basic breeding parameters, 3) recruitment and mortality rates, 4) habitat selection at the general, territorial and nest-site levels, 5) habitat factors that are correlated with territory quality, and 6) cues that elicit territorial behaviour in CIO.

METHODS

To determine distribution and abundance of CIO, a census was conducted from 13–18 December 1998. To determine habitat use of CIO, the lagoon, shoreline and coastlines of Chatham, Pitt, and Rangatira Islands were mapped and habitat use by CIO recorded. Aspects of breeding biology, nest-site selection and use of habitat types within territories were studied for 15 CIO pairs along the north coast, Chatham Island during the 1994, 1995 and 1996 breeding seasons. To identify factors limiting the population, territory quality was explored by comparing breeding parameters between territories and under different levels of management (none, low and intensive), and data on survival of first year birds were also collected. Because territorial behaviour plays such a key role in population dynamics, cues which elicit defence behaviour in CIO breeding pairs were explored using seven different two-dimensional models.

KEY FINDINGS

Distribution and abundance

Along 310 km (97%) of the coastline of the islands, and 100 km (100%) of the lagoon shoreline, a total of 142 CIO were counted. About 85% of CIO were located along the coastlines of Chatham and Pitt Islands. The census indicated an increase of about 20–40 adults over any previous count, although variations in methods of past counts made comparisons difficult. The main increases were along the north coast, and there has been a gradual decline on Rangatira Island.

Breeding biology

Breeding effort was high with 98% of pairs attempting to breed (n = 42 pair-seasons). A clutch had a 20% chance of being successful (at least one egg surviving to produce a fledgling). Overall productivity averaged 0.44 fledglings/pair/season. Flooding was the main cause of egg loss (48%), followed by causes unknown (26%). Juveniles dispersed/were evicted from their natal territories within about 33 days (range 24–42) after fledging.

Habitat selection

277 kms of coastline (92%) and 100% of the lagoon shoreline were mapped. CIO used coastline, rather than the lagoon shoreline, almost exclusively (98% of sightings). Intertidal rock platforms and wide sandy beaches were selected in much greater proportions than available. The highest densities of territories were 4 pairs/km at Tioriori, along the north coast, Chatham Island. Depending on the habitat types available within territories some pairs used rocky platform extensively for feeding (up to 60% of the time spent foraging), while others used sandy beach almost exclusively (76–95%). Paddocks were used for foraging up to 22% of the time by pairs. This extensive use of sandy beach and paddock is either a recent development or was previously under-detected.

Territory quality and season of limitations

Over-winter habitat is probably not critically limiting based on the high survivorship rates (71% and 83% minimum) of first-year CIO. Productivity was much higher during periods of intensive management (e.g. predator control, fencing to exclude livestock, nest manipulation). Territories containing only sandy beach were the most productive under all management scenarios (none, low, or high intensity).

Nest site selection

CIO chose nest-sites along the widest sections of beach available, mostly on sandy beach (77% of nests), but occasionally on rock outcrops (23%). They avoided nesting within five metres of vegetation or the mean high tide line. The establishment of introduced marram and high predator pressure has probably had a significant impact on nest site availability and quality for CIO on the Chathams.

Territoriality

CIO aggressively attacked all the models that were shaped like an oystercatcher, but attacked those with CIO-like colouration most quickly and vigorously. The model with the least asymmetry (i.e. same colours and size) received the most warning behaviours. The pairs in lower quality territories were the least aggressive. Models also proved useful for determining territory boundaries and capturing birds.

The foraging behaviour of oystercatchers (*Haematopus ostralegus*) in relation to food depletion during winter on the river Exe estuary, England

(2000, PhD thesis, University of Exeter, Exeter, UK)

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This thesis presents findings on the foraging behaviour of the Oystercatcher *Haematopus ostralegus* and its feeding environment. The winter foraging of ventrally hammering Oystercatchers on mussels *Mytilus edulis* was studied in relation to food depletion over a period of three years, from September 1996 to March 1999 on the Exe estuary, England. Over-winter growth of mussels was small in all relevant size classes and did not substantially replace the depleted mussels. The overall natural mortality rate was low: only 2.9%. In total, 22.7% of mussels disappeared between October 1996 and March 1997. The largest reductions were found in mussels of length between 30 and 50 mm. The Ash Free Dry Mass (AFDM) of the mussels declined within all the length classes and the small mussels lost the highest amount of flesh.

Of the mussels opened by Oystercatchers, 70.8% mussels were between 35 and 55 mm long. Opened mussels tended to be ventrally thin, flat, brown coloured and to have few barnacles on the ventral surface. Ventral thickness and colour had independent effects on mussel selection. The Oystercatchers strongly preferred brown coloured mussels, probably because the flesh of black-coloured mussels was much wetter than that of the brown-coloured mussels. By avoiding the ingestion of this extra water, the Oystercatchers increased their intake rate by 1.99% to 17.7% in different length classes of mussels. Over the course of winter, Oystercatchers took mussels with increasingly thick shells relative to those that were on offer, particularly in the most preferred length class of 40–50 mm.

Oystercatchers preferentially opened mussels through the right valve. This preference did not change either with mussel length or across the season. The right valve was generally thinner than the left, but the preference for right valve attack was greater than could be accounted for by this factor alone. The preference would be explained if Oystercatchers were able to detect the thinner valve in a mussel when the difference in the ventral thickness between the two valves was more than 0.036 mm. If they were unable to discriminate the thickness difference, then they attacked the right side because 58% of mussels are thinner on this side. By following this strategy, Oystercatchers would need 15.5% less blows than if they attacked either valve at random. The improvement in the overall intake that could be achieved by valve thickness discrimination was 3.6%. The valve thickness asymmetry is common in mussel populations in the Southwest of England and Oystercatchers attacked the thinner valve preferentially in all the areas.

The effort required to break mussels increased with length, ventral thickness and width. Taking these factors into account, the strength of mussels declined rapidly until 16th November and remained consistent until 17th January, after which strength showed a slow progressive increase for the remainder of the season. A change in the mussel shell's crystal structure takes place over the winter, and it is assumed that this affected the ease with which the mussel could be cracked.

The winter seasonal variations in the foraging behaviour amongst the Oystercatchers were analysed with multiple regression models. This allowed greater control over confounding variables. The length of mussels opened by Oystercatchers decreased until 21st December, and from then the birds took increasingly large mussels, maintaining this trend until the end of the winter. The search speed (defined as "time to make 5 paces") decreased across the winter until 21st November, after which it gradually increased. The frequency of "short pecks" (last for <3s) increased whereas the frequency of "long pecks" (last for >3s) decreased across the winter. Successful handling time and hammering time rose to a peak around 20th and 21st December and then remained constant until the end of winter (i.e. until March). Successful carrying time increased throughout the winter. Rejected mussel size was first decreased and then increased across the season. Waste handling time declined initially and then increased around mid-winter, and again declined towards to end of winter. The feeding rate declined throughout the winter. The waste hammering time and waste carrying time did not change across the season. There was a hint that the number of mussels rejected between two successful mussels first decreased and increased. The decline in interference-free intake rate was halted on 20th January, after which it began to increase. Most of the observed overwinter decrease in interference-free intake rate occurred because the flesh content of individual mussels decreased by about half. The reduction in intake rate over the winter that can be attributed to changes in the food supply, part of which was due to the Oystercatchers themselves, amounts only to 6.3% of the initial intake rate in autumn. Hence any depletion of the mussel food supply by the ventrally hammering Oystercatchers themselves is unlikely to be the major factor influencing the overwinter survival of these Oystercatchers on the Exe estuary.

The role of night-feeding in shorebirds in an estuarine environment with specific reference to mussel-feeding oystercatchers

(2000, D.Phil thesis, University of Oxford, UK)

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The shorebirds (Charadrii) that are adapted for foraging in intertidal habitats can only do so when their feeding sites are exposed by the tide. Most have been recorded as feeding at night but the importance of this has rarely been evaluated. This thesis explores the role of night-feeding in those Eurasian oystercatchers *Haematopus ostralegus* that specialise in depredating the common mussel *Mytilus edulis*. Fieldwork was carried out on the Exe estuary, SW England.

Radio-tracking showed that oystercatchers normally feed on the same mussel-beds at night as by day. Between-bed movements occur more often during neap tides than springs. Higher bird densities on neaps (leading to greater intra-specific interference and therefore, for many, less profitable foraging) may be the reason for the tendency to try alternative sites.

One oystercatcher, whose time-budget was monitored by radio-telemetry, fed for similar periods on day and night tides. This suggests that it was indifferent to the changed conditions and showed no choice for feeding more by day or by night.

Observations during August–February using video (with infra-red illumination at night) showed that the three groups of mussel-feeders – ventral hammerers, dorsal hammerers and stabbers – behaved in much the same way by night as by day. Ventral hammerers and stabbers changed from sight-location of prey by day to touch-location at night whereas dorsal hammerers used sight-location day and night. Each group took mussels from different microhabitats: ventral hammerers from among weed (probably because they are more easily detached), dorsal hammerers from among mussels exposed on the surface (probably because they are more easily hammered *in situ*) and stabbers from under water (probably because they are more likely to have gaping valves).

Ventral hammerers achieved similar instantaneous intake rates day and night. Dorsal hammerers had lower intake rates at night when they showed positive correlation with illuminance (probably because they search by sight). The intake rates of stabbers were lower by night than by day in autumn but the reverse in winter. This arose because the time it took stabbers to find mussels at night decreased from autumn to winter. This may be linked to changes in the feeding behaviour of mussels.

Previous studies in daytime had shown higher intake rates in both of the hammerers than in stabbers. It was therefore thought that stabbers are less fit. This study reveals that the fitness of stabbers may not be so different because of the high intake rates they achieve in winter.

It is concluded that, for oystercatchers, night-feeding in intertidal environments is an essential part of their strategy for fulfilling their daily food requirement for which they are well-adapted.
