THE EFFECT OF SEVERE WEATHER IN JANUARY AND FEBRUARY 1985 ON THE CONDITION OF DUNLINS AND REDSHANKS ON THE ORWELL ESTUARY

by Roger Beecroft and Reg Clark

INTRODUCTION

Seasonal cycles of mass and fat are widespread in waders in the harsher parts of their wintering ranges (e.g. Pienkowski, Lloyd and Minton 1979; Davidson 1981, 1982). Reserves are believed to be regulated for use during periods of harsh weather, to balance high energy requirements and low food intakes. After their depletion during harsh weather, reserve levels usually return to those normal for the time of year (Dugan, Evans, Goodyer and Davidson 1981, Davidson 1981).

This paper reports the total mass and estimated fat loads of Dunlins *Calidris alpina* and Redshanks *Tringa totanus* on the Orwell estuary (51°58'N 01°18'E), in south-east England, during the 1984/85 winter, and focusses on the impact of two periods of severe weather, in January and February 1985. Redshanks appear particularly susceptible to many severe spells in Britain (see e.g. Davidson 1981, Davidson and Evans 1982). Data was collected during studies of the effects on waders of a proposed expansion of Felixstowe Docks, at the mouth of the Orwell estuary (Davidson and Evans 1985, O'Brien and Ravenscroft 1985).

METHODS

Birds were caught with mist-nets at Fagbury, on the lower Orwell estuary, between October 1984 and March 1985. Fagbury is 60 hectares of intertidal mud, saltings and disused oyster-beds. Most of the birds were caught on the oyster-beds during the two hours before high tide, and so will have had a similar amount of time on the feeding grounds before capture. Birds that fed on the oyster-beds had mostly fed on the Fagbury mudflats during low water (pers. obs.). After capture all birds were weighed (to 1 g) using a Salter balance. Wing-length (maximum chord) using a stopped rule (to 1 mm) and bill-length (exposed culmen) using vernier calipers (to 0.5 mm) were measured on each bird. All birds were processed within half an hour of capture. The expected weight loss in captivity would be at most 0.5g (Lloyd, Pienkowski and Minton 1979), so no adjustments for weight loss has been made in the analyses that follow.

Lipid indices were calculated by first estimating the lean (=fat-free) mass of each from its wing-length and bill-length, using the formulae $(0.014WL + 0.022BL + 1.96)^3$ for adult Redshanks, $(0.015WL - 0.052BL + 4.77)^3$ for first-winter Redshanks (Davidson 1983), and $(1.4209 \times 10^{-2}WL + 1.3703 \times 10^{-2}BL + 1.5291)^3$ for adult Dunlins (Davidson, Uttley and Evans in press). Fat load was then calculated by subtracting estimated lean mass from total mass. Mean lipid indices (fat as a percentage of total mass) were calculated for each netting session (except where small samples were caught on consecutive days, when these have been combined to give a larger sample). The lean mass of Dunlins varies geographically (Davidson *et al.* in press): since no formula has been published for first-winter Dunlins from the Suffolk/Essex coast we have not estimated the lipid indices of these birds.

Although most changes in estimated lipid index will reflect to changes in fat reserves during periods of severe weather, some of the losses of condition may involve also protein reserves. Our methods do not allow spearation of the relative contributions of use of fat and protein reserves to changes in total mass.

Most Dunlins and Redshanks could be aged by plumage characteristics. However, some Redshanks caught late in the winter could not be aged with certainty. These (except for those that were recaptured, and so were of known age earlier in the season) have been excluded from our calculations. Meteorological data was obtained from Landguard Point, 3 km seaward of the study area. Windchill was calculated from the formula $W = TV^{1/2}$ where T is the temperature deficit below 20°C and V is the wind speed in knots (Davidson 1981).

WEATHER CONDITIONS

Two periods of severe weather occurred in January and February 1985 (Figure 1). During the first period the mean daily temperature reached above 0°C on only one day between 5-17 January. The mean daily wind speed remained below 18 knots throughout this period.

During the second period, mean daily temperature was below 0°C on all but one day between 9-19 February. Wind speeds were much higher than in January: on five consecutive days from 8 February mean daily wind speed exceeded 20 knots. This combination of strong winds and low temperatures resulted in high windchill factors, exceeding 95 on four consecutive days from 9 February.

RESULTS

Dunlin

The lipid indices of adult Dunlins (Figure 2b) increased significantly from an average of 0-2% in late November to 4-8% in early December (Students $t_{271} = 4.81$, $P<0.001$). The mean lipid index in the second half of December was 2.7%, a significant lower than during the first half of the month ($t_{365} = 4.12$, $P<0.001$). After the end of the first cold spell in mid-January the lipid indices had increased to their highest level of the winter: the birds caught between 18 January and 3 February averaging 8.4%; significantly higher than earlier in the winter ($t_{233} = 4.80$, $P<0.001$). By midway through the second cold spell lipid indices had decreased markedly and significantly to average only 0.7% ($t_{119} = 3.44$, $P<0.001$). The pattern of total mass change was similar to that of estimated lipid indices (Figure 2a). The mean mass of first-winter Dunlins (Figure 2c) was very variable from mid-December onwards. This variation seems largely a consequence of differences in mean body size between catches. Thus further assessment of the body condition of these birds is difficult. We caught only few first-winter Dunlins after December, and their

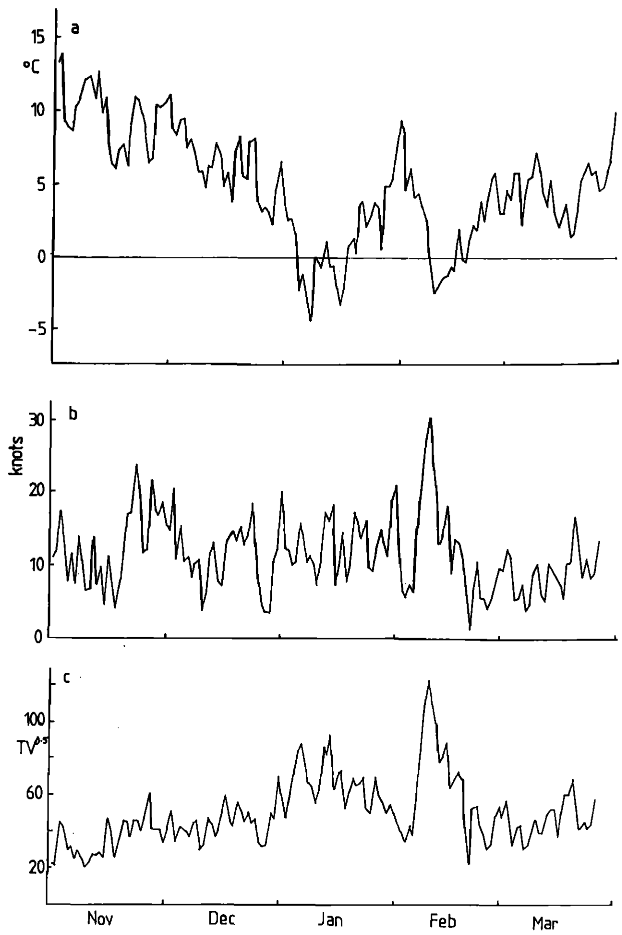

Figure 1. Weather conditions at Landguard Point during winter 1984/85;
a) mean daily air temperature (°C), b) windspeed (knots), and c) windchill ($TV^{1/2}$).

patterns of condition are unclear. However, total masses suggest that at least some of these birds still carried substantial fat reserves after the January cold spell.

Figure 2d shows that Dunlins first weighed in December 1984 and recaptured at the end of the first cold spell had lost weight (4 birds) or remained at the same weight (1 bird), despite the average condition of Dunlins having increased
at this time. The largest weight loss was by a first-winter bird, which had lost 9 g in 21 days. Three of 4 recaptured birds caught 1-2 weeks later had increased their mass, whilst the mass of one remained unchanged.

Redshank

Figure 3 shows that the lipid indices of adult Redshanks averaged 10-18% during November and December. By the end of the first cold spell (January) lipid indices were all below 0% i.e., total mass was below the estimated lean mass for birds in normal condition, implying use of protein as well as fat reserves. The decrease between the last 10 days of December and mid-January was significant (t_{49} = 6.85, P<0.001). Within a week of the end of the cold spell lipid indices had increased significantly, with the mean lipid indices of more than 10% in late January and early February (t_{41} = 6.09, P<0.001). There was no significant difference between the lipid indices of adults in late December and late January/early February. Only two Redshanks were caught during the February cold spell, but both these were very emaciated, with total mass 25% below estimated normal lean mass. In March lipid indices were again higher, averaging 2-10% on different days. Total mass (Figure 2a) followed a similar pattern to the estimated lipid indices.

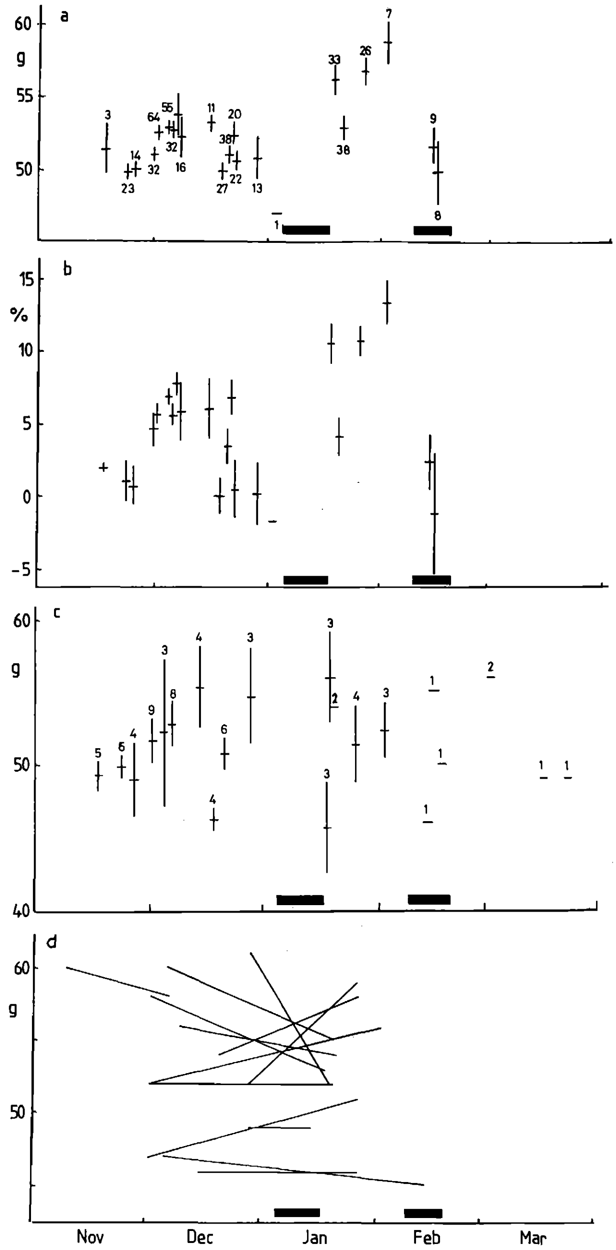

Figure 2. Body condition of Dunlins on the Orwell estuary during 1984/85.
a) total mass of adults; b) lipid index of adults; c) total mass of first-winter birds; and d) mass changes of birds recaptured during winter 1984/85. For a) to c) points show the mean (horizontal line) ± 1 SE (vertical line). Samples sizes and severe weather (horizontal bar) also shown.

Comparison of Figure 3a and 3d shows that the

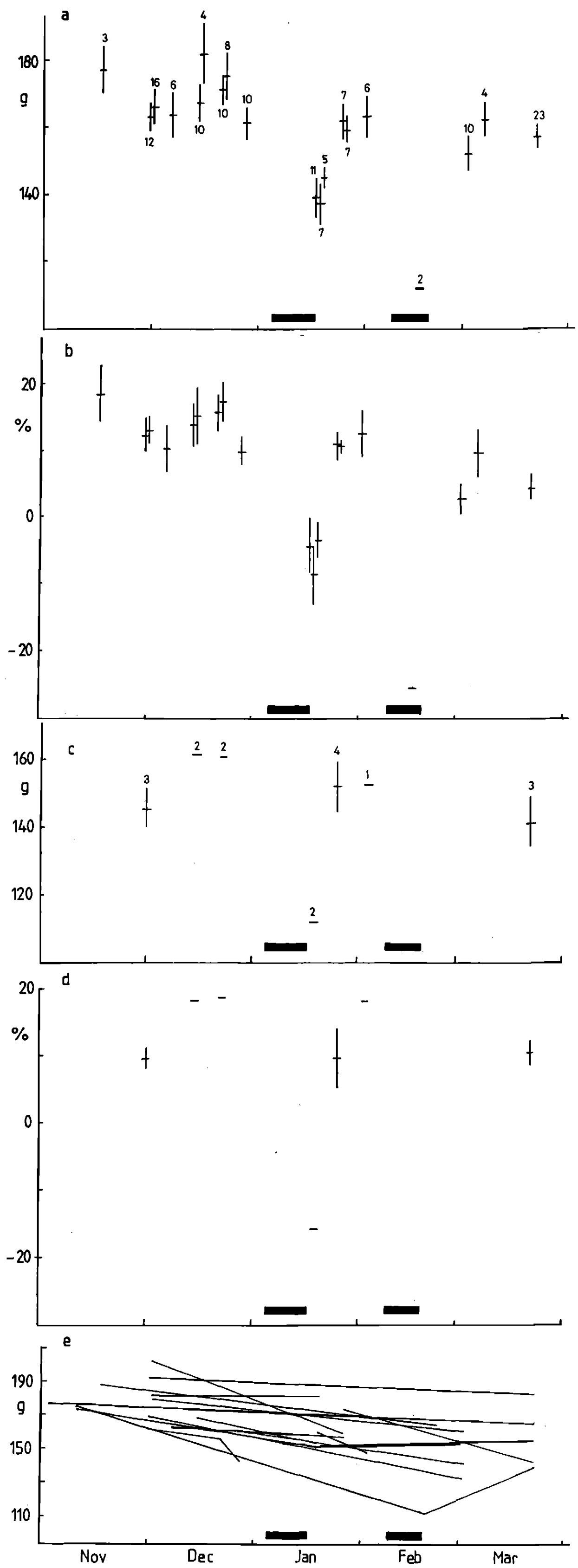

Figure 3. Body condition of Redshanks on the Orwell estuary during 1984/85.
a) total mass of adults; b) lipid index of adults; c) total mass of first-winter birds; d) lipid index of first-winter birds; and e) mass changes of birds recaptured during winter 1984/85. Symbols as Figure 2.

lipid indices of first-winter Redshanks followed a similar pattern to those of adults. There was a sharp decline in mean lipid index, from 18% in the last half of December to -15% (i.e. well below the normal lean mass) by the end of the January cold spell. Lipid indices were around 10% within a week after the end of the cold spell. No first-winter birds were caught during the second cold spell.

Most recaptured birds decreased in total mass during the winter (Figure 3e). Only one Redshank was captured during a cold weather period and again later. This bird weighed 175g when first caught in early November. By the end of the second cold spell (on 18 February) it weighed only 114g, but had recovered to 140g by 23 March.

DISCUSSION

Although we have no pattern of total mass from a mild winter for comparison, we can assume that waders were in their "normal" winter condition before the onset of the first cold spell in early January. Further north in eastern Britain Dunlins reach peak mass in late December and early January (Pienkowski *et al.* 1979, 1984), yet on the Orwell the mean lipid index had already started to fall by mid December, perhaps because weather conditions are usually less severe than further north.

Adult Dunlins can withstand some periods of severe weather in eastern England without apparent loss of condition (Davidson 1981). During the first cold spell on the Orwell fat loads of adult Dunlins increased, apparently in response to the onset of severe weather. Although temperatures were low at this time, wind speeds remained below 18 knots, and windchill increased only slightly. These conditions seem not to have caused Dunlins any difficulty in achieving high food intakes. Such food intake may have been achieved at least partly by extending their feeding time during each tidal cycle, since in early winter few waders were seen feeding at night at Fagbury, but when the weather deteriorated many waders, including Dunlins and Redshanks, continued to feed after dark whilst the mud was exposed. In February, when windchills were much higher, fat loads declined more rapidly and reserves appear to have been used extensively. In some recent cold spells Dunlins have died of starvation in north-east and southern England after using some or all of their fat reserves (e.g. Davidson and Clark 1985). The mean mass of adults in January averaged 54.9 g, close to the 55 g on the Wash at this time of year (Pienkowski *et al.* 1979). During the second cold spell the weights averaged 50.8 g, again similar to the February average of just below 50 g at the Wash. However, although the mid-February mass was similar to those on the Wash, the mass decrease from early February (58.9 g) to that during the February cold spell in the middle of the month was more rapid than might be expected.

During both cold spells in 1985 the numbers of Dunlins on the Orwell increased, but most immigrants settled on the upper reaches of the estuary, rather than Fagbury. Fagbury is a preferred site for Dunlins and individuals mainly fed there throughout the winter (Davidson and Evans 1985). Most of the birds weighed during this study therefore belonged to the winter resident population at Fagbury, so changes in condition should reflect those of individuals.

The formulae for calculating lipid indices of Redshanks were derived from birds overwintering further north, at Teesmouth. Since Dunlins have lower lean masses on milder estuaries (Davidson *et al.* in press), we would expect that the lean masses of Redshanks might be higher at Teesmouth, as the winter weather on the Orwell is usually milder. However, the mid-winter weights are similar at Teesmouth and the Wash (Davidson 1982).

The decrease in mass and lipid index during the cold spells shows that Redshanks on the Orwell, as has been found elsewhere (e.g. Davidson 1982, Davidson and Evans 1982, Davidson and Clark 1985), are very susceptible to severe weather, and that they used fat and protein reserves during cold weather even when wind speeds were low. During the high winds and low temperatures of February 1985 some surviving Redshanks became extremely emaciated; others died on the Orwell and elsewhere on the Suffolk/Essex coast. Davidson (1982) suggested that Redshanks wintering further north on the east coast were unable to regulate their body condition during even mild winters. Redshanks on the Orwell did regain condition rapidly when weather conditions improved after the January cold spell: mean mass increased at the rate of 2.5 g per day during the week after the end of the first cold spell. The mean daily wind speeds did not exceed 20 knots during this period, which probably allowed them to feed unimpeded on the open mud flats which form their preferred habitat (Davidson 1982). In eastern England the failure of Redshanks to regulate reserves may result from continually inadequate food intake (Pienkowski *et al.* 1984), but the mass increase at the end of January 1985 means that this cannot be so on the Orwell. Similarly the high estimated lipid indices during early winter suggest that Redshanks may be able to regulate their reserves on the Orwell in the absence of severe weather. Thus the east coast region in which Redshanks cannot regulate reserves may start further north than the Suffolk coast.

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