THE EFFECTS OF SEVERE WEATHER IN 1978/79 AND 1981/82 ON SHOREBIRDS AT TEESMOUTH: A PRELIMINARY VIEW

by N. C. Davidson

Recent evidence has suggested that the weather conditions giving rise to the greatest problems for shorebird survival differ in different species. For example, Dugan et al. (1981) found that Grey Plovers Pluvialis squatarola were unable to feed on open mudflats at Teesmouth during gales. I have suggested that other long-legged shorebirds, such as Bar-tailed Godwits Limosa lapponica, Curlews Numenius arquata and Redshanks Tringa totanus, and also those that forage visually, such as Ringed Plovers Charadrius hiaticula, also have most difficulty during gales in finding sufficient food to maintain an energy balance (Davidson 1981a). Gales buffet the birds, preventing visual feeders from making accurately-directed attempts to capture prey, and also increase their rates of heat loss. Short-legged shorebirds that feed by touch, such as Dunlins Calidris alpina and Knots C.canutus, appear to be less affected by gales, and face their greatest feeding difficulty during periods of low temperatures, when mudflats become frozen. These differences mean that shorebirds, even those feeding in mixed-species aggregations on a single mudlfat, are likely to be affected to different extents by the same period of 'severe' weather (Davidson 1981a,b). Any differences in the weather conditions during each 'severe' winter should result in each species being differently affected in each winter.

In this note I make a preliminary comparison of the effects of two recent severe winters on shorebirds at Teesmouth, north-east England. Much of the information concerning January and February 1979 is drawn from Davidson (1981a,b), Dugan et al. (1981) and Evans (1981). Some effects of a short period of severe weather in February 1978 are also discussed. Most of the data comprise weights, body condition and mortality. Lean weights and lipid indices (weight of fat expressed as a percentage of total body weight) of live birds were estimated from formulae relating wing-length and bill-length to lean weight (Davidson in press).

Weather Conditions in the Severe Winters

Some features of the weather during the recent severe winters are summarised in Table 1. The main difference in weather conditions was that, on one quarter of the days in January and February 1979, but never in December 1981 and January 1982, the average daily windspeed exceeded 25 knots. The minimum air temperature fell below 0°C on a similar number of days in each winter. The maximum air temperature remained below 0°C on only a few days in each winter. However, during periods of freezing weather, temperatures were lower in December 1981/January 1982 than in January/February 1979: minimum air temperature was below -5°C on 17 days in the former, but only 10 days in the latter. These differences predict that any effects, on shorebirds, of high winds would have been more marked during January/February 1979 than December 1981/January 1982, but any due to low temperatures would have been slightly greater in December 1981/January 1982 than during the earlier cold spell.

Mortality

Tideline searches revealed corpses of few shorebirds that had starved to death during either January/February 1979 or December 1981/January 1982. In the latter cold spell, only two Redshanks and one Curlew were found within the Tees estuary. This suggests that in neither period did any shorebirds at Teesmouth suffer the heavy mortality that occurred elsewhere (Clark, this issue). However, there is evidence that the mortality rates of several shorebirds were higher in 1979 than in other recent, mild, winters (Table 2). Birds known to have died for reasons other than starvation were excluded from this analysis. Assuming equal mortality between November and March in each of the four winters between 1977/78 and 1980/81, then 10% of the normal winter mortality of each species would have occurred in January and February 1979. However, in seven out of the ten species for which there are ringing recoveries, the number of ringed birds found dead during January and February 1979 exceeded 25% of the total in the four winters (Table 2). When data for all species are combined, and the difference in the length of the time periods taken into account, the number found dead during January/February 1979 was significantly higher than during periods of mild weather between 1977/78 and 1980/81 ($G = 13.02, P < 0.001$). (Expected values were calculated by dividing the total number found dead in proportion to the time periods involved.) No ringed Curlews, Bar-tailed Godwits or Turnstones Arenaria interpres were found dead during early 1979. The small sample sizes do not allow more detailed analysis, and the values in Table 2 are not adjusted for differences in the number of birds ringed, and so that could be found dead, in each year. Data on ringed birds found dead in December 1981/January 1982 are not yet available.

Independant evidence for higher mortality at Teesmouth during early 1979 than in other recent mild years comes from Evans (1981), who calculated minimum survival rates (and so maximum mortality rates) for five shorebirds (Grey Plover, Curlew, Bar-tailed Godwit, Turnstone and Sanderling Calidris alba), based on sightings of live, individually colour-ringed, birds in subsequent winters. In all five species, mortality rates, although still low, were higher between autumn 1978 and autumn 1979 (12 - 37%) than between 1975 and 1978 (0 - 20%). However, the mortality rate of Grey Plovers between autumn 1978 and autumn 1979 is now known to be lower than calculated by Evans (1981), since recent evidence (Townshend, this issue) suggests that some Grey Plovers appear at Teesmouth only during severe winters. Mortaility rates for 1981/82 cannot be calculated from colour-ringed birds until those returning next winter (1982/83) have been identified.

Sub-lethal Effects

Shorebirds store fat and protein reserves in winter as an insurance against periods of severe weather, when they cannot satisfy their energy and protein requirements only from feeding (Evans & Smith 1975, Pienkowski et al. 1979, Dugan et al. 1981). Normal winter body condition has been established for several species of shorebirds that spend the winter at Teesmouth (Davidson 1981a,b), so comparisons can be made, for some species, between weights and body condition in the two periods of severe weather and normal (mild winter) body condition.

Grey Plovers. Six Grey Plovers on 12 January 1979 weighed an average of 137g. Since the normal winter lean weight of Grey Plovers averages 210g, they had used not only all their fat reserves, but had also lost about 35% of their normal lean weight. Despite being close to the level of emaciation at which shorebirds often die (Davidson 1981a), five of these six birds are known to have survived (the fate of the other bird is not known), and one had regained its normal condition within one month (Dugan et al. 1981). Poor condition on 12 January 1979 was attributed to five days of high winds that prevented feeding and caused loss of condition, followed by six days of low temperatures, and consequently high energy demands, that prevented birds from regaining condition. Grey Plovers at other times in 1978/79 were in normal condition (Figure 1). Most Grey Plovers weighed during the 1981/82 winter also carried similar fat reserves to birds in normal condition in other winters (Figure 1). However, one bird weighed on 22 December 1981, after 14 days of low temperatures, probably carried little fat since its total body weight (215g) was near the normal winter lean weight for a bird of its body size. This bird, which was colour-ringed, was known to be still alive in mid-January. Three other weighed during the severe weather were in normal condition for the time of year, as were three in late January, after the severe weather. Thus there is no evidence that any Grey Plovers had become emaciated, in contrast to the situation in early 1979.

Table 1. Features of severe weather during January/February 1979 and December 1981/January 1982. Data from Hartlepool, Co. Durham, GB. Numbers in parentheses give percentage of days.

	29 Dec. 1978 - 31 Jan. 1979	1-28 Feb. 1979	7-31 Dec. 1981	1-16 Jan. 1982
Total no. of days	34	28	25	16
No. of days when:				
mean windspeed > 25 knots	9(26)	6(21)	0	0
max. air temp. < 0°C	3(8)	2(7)	0	2(13)
min. air temp < 0°C	20(59)	10(36)	17(68)	11(69)
min. air temp. < -5°C	10(29)	0	9(36)	8(50)

Table 2. Recoveries of ringed shorebirds found dead by the general public at Teesmouth during the four winters (November - March) between 1977/78 and 1980/81.

	No. found dead*			% found dead
	Jan/Feb. 1979	1977/78 to 1980/81 excluding Jan/Feb. 1979	1977/78 to 1980/81 including Jan/Feb. 1979	Jan/Feb. 1979
Ringed Plover	1	1	2	50
Grey Plover	1	0	1	100
Knot	2	5	7	29
Sanderling	2	2	4	50
Dunlin	4	2	6	67
Bar-tailed Godwit	0	1	1	0
Curlew	0	2	2	0
Redshank	1	2	3	33
Turnstone	0	4	4	0
Oystercatcher	1	0	1	100
Total no. found dead	12	19	31	39
mean no. /month	6.00	1.05	1.55	

* Recoveries for which there is evidence of accidental death (e.g. predated by raptor, shot, flew into wires) are excluded.

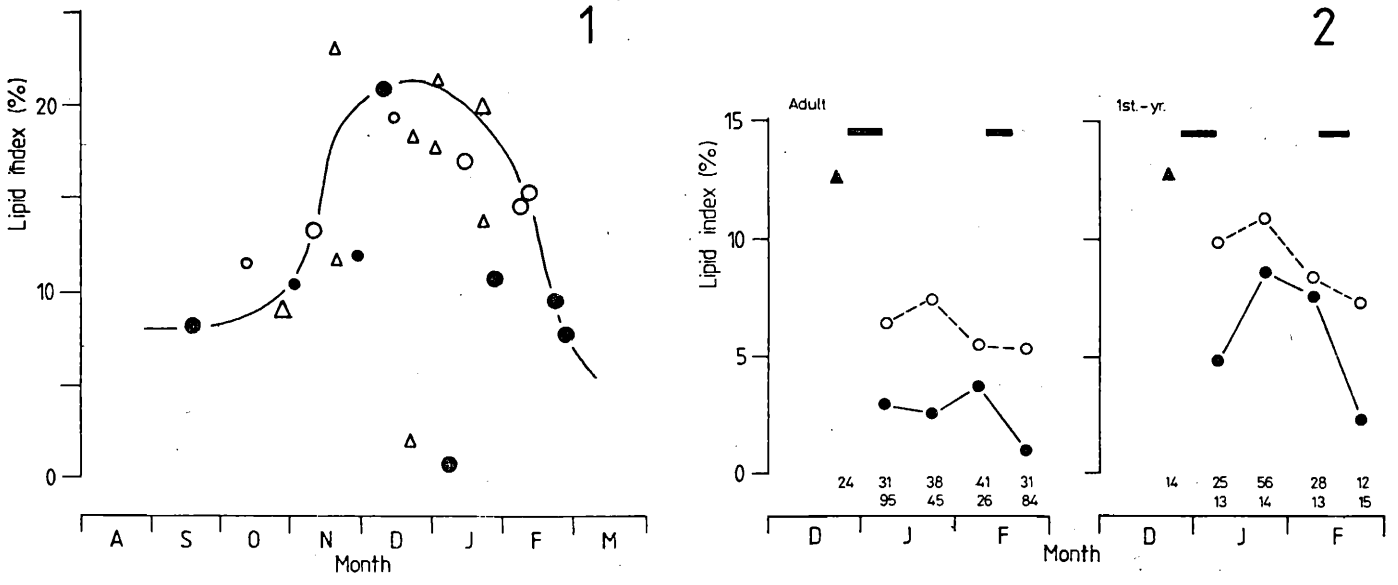

Figure 1. Mean lipid indices estimated from the total body weights of Grey Plovers at Teesmouth during the 1978/79 winter (●), 1981/82 winter (Δ), and other years (O). Small symbols are single birds. Trend line fitted by eye. Data, other than for 1981/82, from Davidson (1981a).

Figure 2. Mean lipid indices estimated from the total body weights of adult and first-year Dunlins at Teesmouth during the severe weather in Jan/Feb, 1979 (—●—), and during a mild winter (Jan/Feb 1980) (—O—). Late December 1975 values (▲) are also shown. Numbers indicate sample sizes. Horizontal bars indicate the periods of most severe weather in 1979. Data from Davidson (1981a).

Dunlins. In 1979, many Dunlins used some of their fat reserves during the severe weather in early January. These were then replenished before being used again during severe weather in late February. This pattern was deduced both from changes in mean lipid indices, estimated from the total body weights of all Dunlins weighed at Teesmouth, and from individual Dunlins weighed twice during January and February 1979 (Davidson 1981b). Mean lipid indices in 1979 were consistently below those during the succeeding mild winter (Figure 2). Only three Dunlins were weighed at Teesmouth during severe weather in 1981/82. However, all three probably carried very little fat, since their total body weights (48g, 50g and 52g) give estimated lipid indices of -3%, -3% and +6%; i.e. two of the three weighed less than their estimated lean weight. If these birds had been carrying the normal amount of fat in midwinter (Davidson 1981b), then they should have been between 6g and 15g heavier than the weights recorded. During a week of cold weather in February 1978, some first-year Dunlins used part of their fat reserves, but the condition of adults remained unchanged (Davidson 1981a). So during each period of low temperatures in winter, at least some Dunlins used some of their fat reserves.

Redshanks. Redshanks were expected to be in very poor condition during severe weather, since there is evidence that some cannot maintain their body condition on the east coast of Britain, even during mild winters (Davidson in press), and often more Redshanks than other shorebirds die during severe weather (Davidson 1981a; Clark this issue). No Redshanks were weighed during severe weather in January 1979, but five birds weighed on 5 February, when weather conditions had improved, had an average estimated lipid index of 6.5%. and so were probably near their normal (mild winter) condition. In the 1981/82 winter, one bird weighed on 22 December, after 14 days of severe weather, was in poor condition, since its total body weight (144g) was 14g (9%) below its estimated lean weight. In contrast, six Redshanks caught in early January 1982, after two weeks of less severe weather, had an average estimated lipid index of 16%. Four birds in late January, 10 days after the thaw, averages 20% estimated lipid index. Both these values are considerably higher than would be expected in a mild winter, and imply that some Redshanks may have been able to recover condition rapidly when weather conditions improved, or had remained in normal condition throughout the severe weather. However, Redshank populations during severe winters may not be directly comparable with those in mild winters. At the start of the severe weather in January 1979, about half (225 birds) of the Redshank population left Teesmouth (Davidson 1981a). Insufficient counts of Redshanks were made during 1981/82 to determine whether a similar departure occurred. The high lipid indices after severe weather could arise if the part of the population that remained consisted of those individuals best able to maintain their body condition during severe weather.

Conclusions

Although the severe weather during January and February 1979 led to increased mortality of shorebirds, neither that spell, nor the most recent one (December 1981/January 1982), caused large-scale mortality at Teesmouth, despite these two winters being amongst the four most severe in Britain during the last 45 years. However, mortality rates do not reveal the complete picture, since although few shorebirds died, many used their internal fat and protein reserves to balance their energy budgets, because of the increased energy requirements, and probably also reduced food availability (e.g. Pienkowski 1981), during the severe weather. Shorebirds, such as Grey Plovers, which face their greatest problems during high winds, appear to have used more of their internal reserves in early 1979, when high winds were more frequent (Table 1), than in December 1981/January 1982. Other shorebirds, such as Dunlins, which are affected mainly by low temperatures, used fat reserves during both periods of severe weather. However, the effects of severe weather on shorebirds can be difficult to interpret if shifts in the populations, such as the movement of part of the Redshank population away from Teesmouth, take place during severe weather. This brief survey shows that the effects of severe weather do differ between years and between species of shorebirds, in addition to the differences known to occur between wintering areas (Clark this issue).

Some further information and material concerning the effects of severe weather at Teesmouth and elsewhere will be analysed once time and resources become available, and some comments, suggesting ways in which future information should be collected during severe weather, will be made in the next issue of the WSG Bulletin. This note emphasises that the effects, on shorebirds, of each period of severe weather must be monitored until a full understanding is achieved of the importance of different factors in affecting body condition and survival of different species in different areas.

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