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The peatlands of Caithness and Sutherland

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Appendix
Methods of ornithological surveys

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Methods of data collection used in these surveys have been described in published reports (see section 3.1) and by Reed (1982b). For most moorland bird species, finding the nest of any given pair is too difficult for this to be a feasible means of population counting over the large areas which have to be surveyed. Observation of adult birds in their nesting territories thus has to be the principal basis of census. A territory mapping method was used, whereby a site was visited several times (usually four) in the course of the breeding season. A pair of observers walked a series of transect lines across the site 200 m apart; thus no part of the site was more than 100 m from an observer.

Once decided, the transect pattern was adhered to, with observers on subsequent visits using the same transects as on the first visit but reversing the direction of walking them on each occasion. Bearings were taken frequently to ensure that the same transect lines were used on each visit.

Weather can adversely affect the number and behaviour of birds seen. Recording was not attempted if there was strong wind (greater than Force 5 or even less in exposed areas), rain, low cloud or fog.

On each visit, observers recorded the birds seen from the transect lines. Each sighting was mapped, using a code (including details of behaviour) marked onto 1:10,000 maps in the field. Any double recording (i.e. when both observers saw and recorded the same bird during a transect) was corrected at the end of each line walked. At the end of each day a single composite map was produced. Not all bird species were recorded in the early years of the surveys. More recently, however, all species encountered have been recorded.

After each site visit the sightings were transferred to a summary map of the site for each species. At the end of the season it was thus possible to determine the number of territorial pairs of each species on each site from the clusters of sightings on the summary map. Birds were accepted as breeding or attempting to breed if one of the following was recorded (Reed, Langslow & Symonds 1983a):

- a nest;
- a pair with young;
- a pair acting as if with young (cf Reed & Langslow 1985);
- a bird or birds present in the same area on two or more occasions showing signs of attachment to the area.

Breeding densities are expressed in this report as pairs per square kilometre.

The analysis of dunlin sightings presents great problems. Dunlins breed semi-colonially, have small territories and do not move long distances to mob observers. Like snipe, they often behave cryptically. Problems of obtaining quantitative estimates of breeding numbers on machair habitat have been discussed by Reed & Fuller (1983), Reed, Williams & Webb (1983), Jackson & Percival (1983), Webb, Reed & Williams (1983) and Fuller, Green & Pienkowski (1983). Whilst dunlins breed at a lower density on blanket bog than on machair, many of the census problems are similar.

Greatest activity, and thus detectability, was found in the period 3-20 June. In estimating the number of pairs present, we followed the method used by Reed & Fuller (1983): the number of single birds 50 m or more from other birds seen during the period 3-20 June (or as close to that period as possible) was taken to represent a minimum number of pairs. This method of analysis differed from that employed for other species in being based on data only from the period of peak activity and not on clusters of records from the whole season.

After the breeding season, vegetation at each site was mapped and then divided into a grid of 200 m × 200 m squares. Details were recorded, using the provisional categories of the National Vegetation Classification (Birks & Ratcliffe 1980). As well as the vegetational composition of each square, details of the structure and physical features were recorded, such as presence of pools and dubh lochans, age and height of vegetation and the

amount of regrowth after muirburn. The selectivity of breeding waders for particular areas within a site could thus be related to detailed habitat information (Reed & Langslow in press).

Seasonal timing of visits

In the course of five years' fieldwork, much effort was expended to identify biases in data collection and to evolve a standard methodology. Emphasis was placed on determination of optimal timing for census visits so that results would be repeatable and would accurately represent numbers of breeding waders (Langslow & Reed 1985; Reed in prep.).

It was found that ideally visits should be spaced about three weeks apart. Sites were usually visited a minimum of four times, with at least three visits between 1 May and 7 July. The most important periods were 16 May to 2 June, 3-20 June and 21 June to 7 July. These correspond to the main periods of territory establishment, incubation and fledging. At least one visit was made during each of the first two periods.

Diurnal timing of visits

In order to eliminate any biases due to differing detectability of waders at varying times of the day, diurnal variation in behaviour was investigated by Reed *et al.* (1983), Reed *et al.* (1985) and Reed & Langslow (in press). Dunlins, curlews, lapwings, snipe and golden plovers all showed significant diurnal differences in detectability.

Detectability was found to be highest in the early part of the day after dawn (before 09.00 hours), dropping to a low point in the early afternoon before rising to a second but lower peak of detectability in the early evening. This had important implications for the scale and timing of surveys.

Where wide-scale censusing was to take place, an early start would have resulted in a biased estimate for areas covered in the first few hours after dawn when compared with results obtained during the rest of the day (Reed *et al.* 1985). Avoidance of early morning starts provided compatible information from site to site. If large tracts needed to be completed within a single day, extension into the early evening activity peak did not seriously affect results (Reed *et al.* 1985). This was because the rise in activity and detectability in the evening was substantially less than in the early morning.

Validation of methods

The methods used for assessing dunlin densities were tested by Jackson & Percival (1983) during the survey of the breeding waders of the machair of the Outer Hebrides carried out by the Wader Study Group and NCC (Reed & Fuller 1983). The methods were checked against intensive nest searches and studies on colour-marked birds in several areas and were found to be consistent, although underestimating by about a third. Further checks were undertaken in 1985 and 1986 with similar results (Fuller 1985; Fuller & Percival 1986). As explained above, the same procedure for estimating the number of territorial pairs was used for the Upland Bird Survey.

The methods used to estimate densities of other territorial waders were tested in 1982 in an area of Wales where RSPB workers had independently searched for nests in an intensive survey of breeding waders. This enabled the method to be checked in terms both of overall numbers found by both methods and of the probability of nest location with respect to distance from the transect. Of seven golden plover nests found by RSPB surveyors, all were located by NCC transects, except that furthest (80 m) from the transect. As a proportion of nests found this was 86%.

In 1982 the transect method was tested at Kerloch, in Grampian Region, on an area of moorland intensively searched by the Institute of Terrestrial Ecology. The ITE personnel used trained dogs to locate all golden plovers in a moorland plot of about 500 ha. This was then surveyed by NCC workers, using the standard transect method. Of the 13 pairs of golden plovers known to be present by ITE, the NCC observers

found 10 (77%) within the study plot. However, one of the pairs was known to have moved into a nearby field, where it was independently located by the NCC observers, who thus located 11 of the 13 territorial pairs (85%).

In no area did the territory mapping locate all nests. Estimates of breeding populations obtained this way must therefore be regarded as minima, particularly for dunlin.

Between-year comparisons of breeding wader populations

In order to investigate more closely between-year variations in wader breeding numbers and to see what implications these have for site assessments based on a single year's survey, Langslow & Reed (1985) surveyed a number of sites in Caithness and Sutherland in consecutive years. Overall, they found that between-year variation in the densities of moorland breeding waders was relatively low and showed no overall trend for all species. The spatial distribution of territorial birds on census plots in relation to the mosaic of habitat types did not vary significantly between years. This suggests that, although most Upland Bird Survey plots were surveyed in only one year, the results accurately represent the quality of the areas as habitat for breeding waders.