SOME DIFFERENCES IN THE WAYS THAT OBSERVERS ESTIMATE NUMBERS OF WADERS BREEDING AT HIGH DENSITY

by R.J. Fuller

Extensive ornithological surveys are often conducted by collating observations from a large number of observers. The "Breeding Waders of Wet Meadows Enquiry" (Smith 1983) and the Wader Study Group/Nature Conservancy Council survey of Hebridean waders (Green 1983) are good examples. An important objective of these and similar surveys is the evaluation of individual sites for wildlife conservation purposes. This process usually relies on comparing population sizes or densities of birds at the different sites. Normally, the assumption is made that variation between the observers is insignificant compared with the real variations in populations. But how justified is this assumption?

Three main sources of observer variation can be distinguished, assuming that field methods are broadly comparable:

a) Differences between observers in their efficiency at detecting birds.
b) Differences in the technique of recording observations.
c) Differences in interpretation which may be partly dependent on the way in which they have been recorded.

Information collected by Wader Study Group observers during the 1983 survey of Hebridean waders has been used to examine the significance of these potential components of observer variation. Fuller, Green and Pienkowski (1983) showed that experienced observers are probably of similar efficiency at detecting breeding waders. It is evident that observers do vary in the detailed way in which they record their field observations, even when a carefully designed standard field method is employed (Webb, Reed and Williams 1983). In many extensive surveys, observers are asked to interpret their own records and to estimate the numbers of birds present. This paper examines how this practice may produce variation in the population estimate.

METHODS

In the 1983 Hebridean wader survey observers worked in pairs using a transect method which is described, together with criteria used to interpret the results, in Reed and Fuller (1983). The present paper is based on the results of the five teams of WSG workers who were asked to estimate the numbers of pairs of waders on each of their study plots from single visits. The only guidance they were given on how to perform this assessment was that they should count apparently paired birds and separate single birds as "pairs". These guidelines were similar to those used in some previous British breeding wader studies (Fuller 1978, 1981, Galbraith & Furness 1983, Smith 1983). Groups of birds were divided by two to obtain an estimate of "pairs". When such a group was an odd number, the odd bird was treated as an extra single; for example, nine birds would be counted as five pairs.

Each survey team produced a "composite visit map" on which all their observations were summarised. A separate "pair summary map" identified the position of each assessed pair of birds. A later comparison of the two maps enabled the basis for defining each pair to be determined and classified either as an observed single bird or as an observed pair. These two basic types of field observations are henceforth referred to as "registrations". In the case of a group of, say, nine birds this would be classified as four pairs and one single bird.

Independent interpretations of the composite visit maps were made by A. Webb and T. Williams using the criteria for denoting pairs which are given in Reed and Fuller (1983). The estimates resulting from the systematic use of these criteria were termed "standard estimates" and these were the estimates used in reporting the official results of the survey (e.g. Green 1983). These standard estimates were then compared with the observers' estimates described above. It is important to appreciate that the standard estimates were made to reduce any variation between observers in their interpretation of the field observations; application of standard estimates could not ensure that the estimate was accurate (i.e. close to the real population). The accuracy of the transect method is discussed in Jackson and Percival (1983).

In this paper the interpretation of field records is examined for Oystercatcher *Haematopus ostralegus*, Ringed Plover *Charadrius hiaticula*, Dunlin *Calidris alpina* and Redshank *Tringa totanus*. The total survey effort of each WSG team was examined and, where more than one visit was made to a site, only the results of the first visit were used to ensure that all the observations were based on different birds. The five teams were labelled A, B, C, D and E and are the same as those in Webb, Reed and Williams (1983).

RESULTS

Differences between species in the way they are recorded

The registrations made by each team are summarised in Table 1. Each species differed in its behaviour (Fuller, Green and Pienkowski 1983) and it therefore seemed likely that there would be differences in the way that each species was recorded. One indication of this was to look for differences in the pair: single ratio between the species. This was done by carrying out a separate chi-squared test on the results obtained by each team which were summarised in a 2 x 4 matrix giving the numbers of registrations that were pairs or single birds for each of the four species. All five analyses were highly significant: in each case X^2 >30.00, P<0.001. Therefore, strong differences existed in the pair : single ratio recorded for different species.

The teams were in close agreement about which species were most frequently recorded as pairs and which were least often recorded as pairs (Kendall's coefficient of concordance = 0.964, P<0.01). In order of decreasing frequency of pair registrations the species were: Redshank (overall percentage of registrations as pairs was 78%; range for the five teams 60-87%), Oystercatcher (70%; 58-79%), Ringed Plover (64%; 51-69%), Dunlin (51%; 29-62%). Thus the greatest variation in recording technique between the teams existed for Dunlin with a range of 33 percentage points. Teams agreed most closely for Ringed Plover where the range in the percentage of pair registrations was 18 percentage points. These variations between the teams are examined in more detail below.

Table 1. The numbers of pairs and single birds recorded by five survey teams. Each of these registrations was the basis of an estimated "pair of breeding waders". Data have been combined from all sites surveyed by each team. Percentages of each registration type are given in parentheses.

	OYSTERCATCHER		RINGED PLOVER		DUNLIN		REDSHANK		TEAM TOTALS	
	pairs	singles	pairs	singles	pairs	singles	pairs	singles	pairs	singles
TEAM A	107(75)	36(25)	115(61)	73(39)	124(51)	121(49)	418(82)	89(18)	764(71)	319(29)
TEAM B	146(74)	50(26)	174(65)	93(35)	254(58)	182(42)	281(87)	43(13)	855(70)	368(30)
TEAM C	229(58)	169(42)	96(51)	92(49)	64(29)	160(71)	210(60)	140(40)	599(52)	561(48)
TEAM D	260(79)	68(21)	194(66)	98(34)	159(62)	98(38)	171(84)	33(16)	784(73)	297(27)
TEAM E	166(69)	73(31)	220(69)	101(31)	99(49)	101(51)	68(78)	19(22)	553(65)	294(35)
SPECIES TOTALS	908(70)	396(30)	799(64)	457(36)	700(51)	662(49)	1148(78)	324(22)		

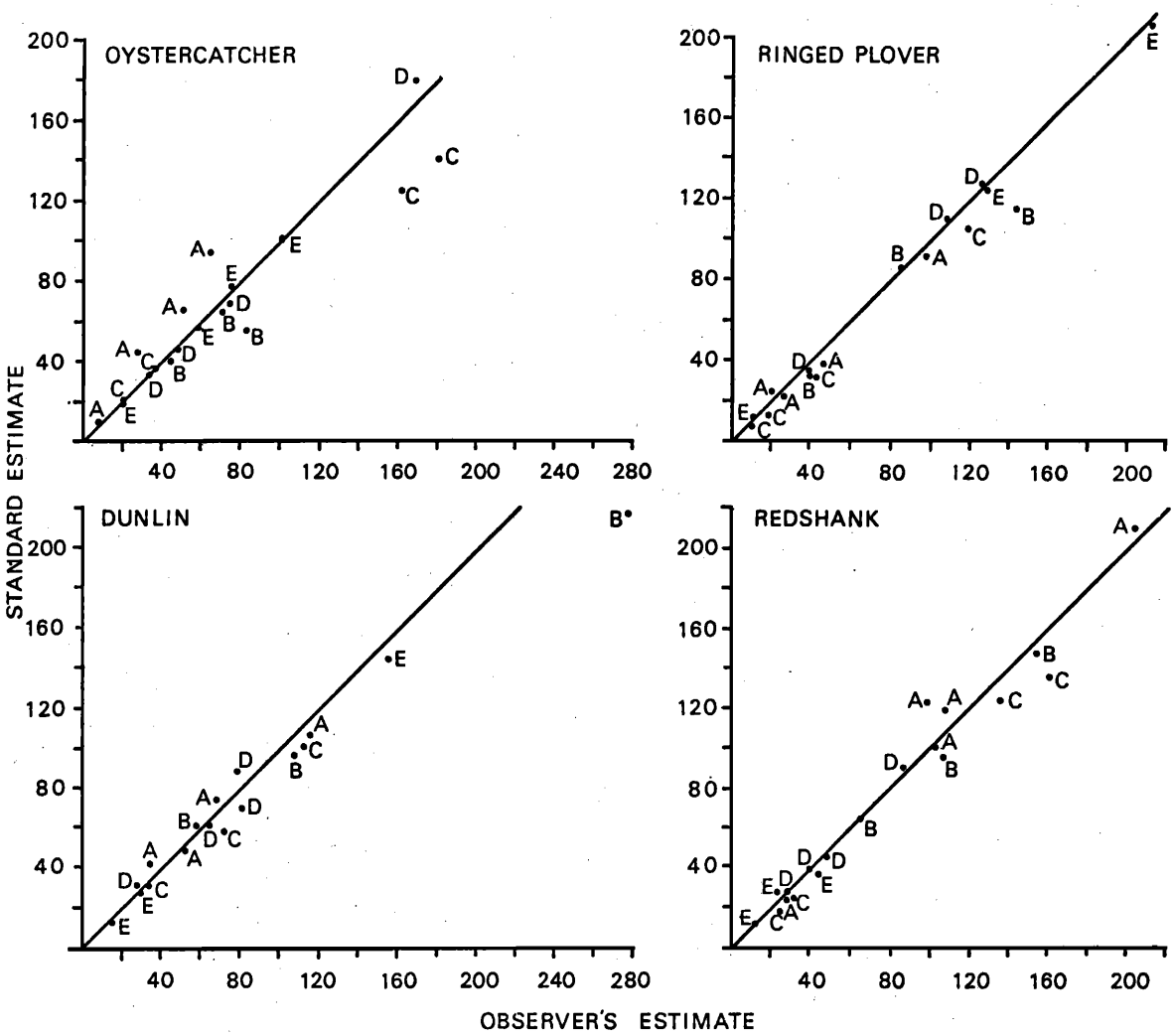

Figure 1. Relationships between observers' estimates of breeding wader populations, and corrected (standard) estimates made using the criteria of Reed & Fuller (1983). The estimates for five survey teams (A-E) are shown separately for different sites: each point refers to one site. Exactly equal estimates would fall on the line.

Differences in the recording techniques of the teams

For each species there were differences in the pair : single ratios reported by the five teams. This was shown by separate 2 x 5 chi-squared tests for each species, in which the numbers of registrations that were pairs or single birds were compared for the five teams. The numbers of registrations are given in Table 1. The results of the tests were: Oystercatcher X^2 = 21.94, P<0.001; Ringed Plover X2 = 17.91, P<0.01; Dunlin X^2 = 66.49, P<0.001; Redshank X^2 = 90.40, P<0.001.

Did some teams consistently record waders, irrespective of the species, as pairs more often than other teams? This was so according to Kendall's coefficient of concordance in which the four species were treated as judges and the five teams as entities (W = 0.69, P<0.01). The sums of ranks (of the percentages of registrations as singles) for the five teams was A, 12.0; B, 15.0; C, 4.0; D, 18.0; E, 11.0. This indicates that team C was exceptional in consistently recording a very low percentage of pairs, and that B and D tended to record more pairs than the other teams.

Table 2. The effect of using standard estimates of breeding wader populations. Numbers (and percentages) of sites are given where observers over- and under-estimated populations relative to the standard estimate. All species have been combined.

	Number of sites where:		
	Observer over-estimated relative to the standard estimate	Observer under-estimated relative to the standard estimate	Estimates exactly equal
TEAM A	8 (40%)	10 (50%)	2 (10%)
TEAM B	8 (67%)	3 (25%)	1 (8%)
TEAM C	15 (94%)	1 (6%)	0
TEAM D	8 (50%)	5 (31%)	3 (19%)
TEAM E	8 (50%)	5 (31%)	3 (19%)

When the above chi-squared calculations were repeated, excluding the results of team C, no differences between teams could be detected (i.e. $P>0.05$) with the exception of Dunlin ($X^2=10.81$, $P<0.02$).

Interpretation of the field registrations

The relationships between the observers' estimates and those made using the criteria of Reed and Fuller (1983) are illustrated in Figure 1. The scatter for Oystercatcher was greater than for other species, perhaps because of the problems observers face in deciding when two individuals are a pair (Fuller, Green and Pienkowski 1983). For Ringed Plover, Redshank and Dunlin the general agreement between the two estimates was close. However, in the case of Dunlin there was one notable exception where one team's estimate of 280 was amended to 217, a decrease of 23%. This site, at the edge of Loch Bee (North Uist), is exceptionally difficult to survey due to an extremely high density of Dunlin, continuous over an area of more than one square kilometre of almost featureless terrain. Nevertheless, it cannot be assumed that the standard estimate is necessarily more accurate than the observer's estimate.

In general, observers tended to over-estimate numbers of waders relative to the standard estimate (Table 2). However, there were some variations between the teams. Team A under-estimated numbers more often than the other teams but, most strikingly, Team C over-estimated numbers far more frequently than any other team. In all but one of Team C's 16 estimates, the effect of standardising was to reduce the population estimate. It is highly probable that this is associated with the tendency of team C to record an exceptionally high proportion of single birds.

DISCUSSION

Each species tended to be recorded in a characteristic way reflected in the relative numbers of pairs and single birds. Redshank with chicks vigorously mob observers, often in groups of birds, and this leads to the high frequency of detection of both members of a pair. Oystercatchers are also commonly recorded in pairs, presumably because they are large and conspicuous. The two smallest species, which are also the most inconspicuous, were least often recorded in pairs.

This paper has shown that there can be significant differences between census teams in the way they record waders using the transect techniques described in Reed and Fuller (1983). Much of the variation between observers was attributable to one team which consistently reported an exceptionally high proportion of single birds. The other four teams recorded waders in the same way, with the exception of Dunlin. This species is extremely inconspicuous and difficult to count on its breeding grounds (Fuller, Green and Pienkowski 1983); clearly the greatest care must be taken when carrying out counts of Dunlin.

What causes this variation between observers? Examination of the composite species maps of Team C showed that many single birds were recorded close together which would certainly have been classified as pairs by many other observers. Furthermore, standardisation of the estimates consistently decreased the population estimates of team C; this was not the case for the other teams. This strongly suggests that team C held a different perception of when two birds constituted a pair. It seems rather unlikely that this team was somehow less efficient, and more often overlooked one individual of a pair. If this was so, one might have expected their recording technique for the two most conspicuous species, Oystercatcher and Redshank, to have been similar to the other teams.

To what extent is this observer variation likely to affect the population estimate? Undoubtedly it is one source of variation in the results. Any tendency to split pairs into single birds would tend to raise the population estimate. This is reinforced by the outcome of applying standard estimates (Table 2) which had the effect of consistently lowering the estimates made by Team C. Nevertheless, the overall effect of correcting the observers estimates was low (Figure 1), particularly for Dunlin, Ringed Plover and Redshank. Therefore, in general, the observers estimates gave a good reflection of the relative numbers of waders on each site. This assumes, of course, that there were no other major differences in recording technique or ability of the teams. It should be pointed out that the observers contributing to the 1983 WSG/NCC Hebridean wader survey were experienced wader counters and that Fuller, Green and Pienkowski (1983) could find little evidence of serious differences in the efficiency of experienced observers.

ACKNOWLEDGEMENTS

I am grateful to all those wader workers who spent countless hours on the Hebridean machair in June 1983. The results of this paper are based on counts made by Richard Burkmar, Nigel Buxton, Tim Davis, Pete Ferns, Ian Forsyth, Rob Fuller, Geoff Johnson, Bozena Kaleyta, Mike Moser, Ken Smith, Fraser Symonds, and Simon Walker. The work was made possible by financial support from World Wildlife Fund, Nature Conservancy Council, Scottish Ornithologists' Club, British Ecological Society, British Ornithologists' Union, British Trust for Ornithology and Royal Society for the Protection of Birds.

Thanks to Andy Webb and Tony Williams for producing the standard estimates and to Nigel Buxton and Mike Moser for convincing the author of the potential significance of "pairs and singles". Mike Pienkowski and Raymond O'Connor kindly commented on a draft of this paper.

SUMMARY

Counts of breeding waders made by five teams of observers in the Southern Isles of the Outer Hebrides in 1983 were used to assess variations between observers in techniques of recording and estimating numbers of birds. Four species were examined: Oystercatcher, Ringed Plover, Dunlin and Redshank. Teams assessed numbers, in terms of "pairs", on the basis of observations of apparently paired individuals (pairs) and single individuals (singles). Each species tended to have a characteristic pair : single ratio. One team, however, consistently recorded a higher proportion of single birds, irrespective of species, than the other teams. This resulted in this team over-estimating numbers of waders relative to the other teams. The size of this over-estimate was small. Independent standard estimates made some correction for this, but generally the observers' estimates closely reflected the standard estimates.

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WSG PROJECT ON THE MOVEMENTS OF WADER POPULATIONS IN WESTERN EUROPE: NINTH PROGRESS REPORT

by M.W. Pienkowski and Ann Pienkowski

INTRODUCTION

This is the final progress report on this project. Funding to employ the coordinators of the project has now finished (although we continue with analysis for the project). The final request for data from ringers produced a very large response. Consequently we are now handling that material, with the help of our three data processing assistants (funds for whom continue for a few more weeks) and of the Durham University Computer Unit. Meanwhile, analysis continues, and there will be a period of relative quiet from us while we complete this! The analysis combines results from the data gathered from ringers, the ringing recoveries from national ringing schemes and Euring, the results of the visible marking projects and the results of the counting studies, such as the Birds of Estuaries Enquiry.

The major problem in making use of ringers' data was the enormous amount of historical information. As the project has been successful in transferring most of these to computer files, we shall try to keep up to date with new ringing. Ringers should therefore continue to submit "green" Wader Study Group forms for current ringing. There may, however, be some delays in our handling of these as analysis of the encoded data must take priority at present.

Most of this report is devoted to thanking the many people who have taken part in the project, as a list of acknowledgements has not appeared since the end of the first year of the study. First, however, we need to outline what is happening with regard to visible marking studies now and in the future.

VISIBLE MARKING STUDIES: PRESENT AND FUTURE

This project

Marking for the present study has now finished. Completion of observer report forms for this project should stop at the end of March 1984 (observers will have been advised of this before the circulation of this Bulletin). Marking for several other projects in the same general areas continue. These projects, which are outlined below, would welcome reports of marked birds, with as much supporting detail as possible, as for the present project.

1984 West Coast of Britain Spring Migration Project

A joint WSG/Birds of Estuaries Enquiry project will be marking birds in April and May 1984 (see *WSG Bull.* 39: 35-36). Many people have already registered as observers for this project, but any further sightings of marked birds will be welcome. Registered observers should send their records of dyed waders in the period April to June 1984, inclusive, to the organiser, Mike Moser (British Trust for Ornithology, Beech Grove, Station Road, Tring, Herts. HP23 5NR, UK). Anyone else should send reports of dyed waders in the western