Studies in Avian Biology No. 2:157–166, 1979.

SHOREBIRD CENSUS STUDIES IN BRITAIN

A. J. PRATER[1]

ABSTRACT.—Studies on shorebirds in Britain and Europe involve the combination of extensive census and intensive banding data. Although such studies are still in an early stage of development, they do provide information needed for effective conservation planning. This paper outlines the techniques used and provides examples of the results which can be obtained on distribution, migration, population fluctuations, and detailed characteristics of each species.

Counts of wildfowl have been made for many years and much information is now available on distribution, migration, and aspects of population dynamics. There is therefore a considerable fund of knowledge on which conservation assessments can be based. On the other hand, shorebirds form a significant proportion of the total avifauna on estuaries and other coastal areas and, in winter, many species utilize only these habitats. Yet, until recently there were no extensive data on the numbers and distribution of passage and wintering shorebirds.

During the last ten years several large development schemes have been proposed for some of the major estuaries in Britain and elsewhere in Europe. These areas were considered to support large numbers of shorebirds but neither the precise number involved nor the relative national or international importance was known. The evaluation of these aspects was considered to be important in efforts to obtain a balanced conservation program. The counts also provided data on fluctuations in numbers of birds between successive years.

The three principal voluntary ornithological bodies in Britain, the British Trust for Ornithology, the Royal Society for the Protection of Birds, and the Wildfowl Trust, joined together to provide the manpower and expertise to carry out the 'Birds of Estuaries Enquiry.' The project was financed by the Nature Conservancy, now the Nature Conservancy Council and the Institute of Terrestrial Ecology. Comparative international data were made available from the Irish Wildbird Conservancy's 'Wetlands Enquiry' and the counts elsewhere in Europe and Africa were obtained by the International Waterfowl Research Bureau's (I.W.R.B.) Wader Research Group.

METHODS

COUNTS IN BRITAIN

Counts were made on almost every estuary within Britain between August 1970 and May 1975; additional data were obtained during a pilot survey between August 1969 and April 1970. All larger estuaries in Britain were counted regularly and additional information was gathered on most small estuaries, larger coastal bays, and sections of rocky coastline. Data were obtained on about 180 areas within Britain.

The counts were made once a month, although for some areas additional data were obtained, and were synchronized with a weekend spring tide. The counts on all larger areas were made during the period two hours either side of high water, when the shorebirds were moving to, on, or dispersing from their high tide roosts. It was possible to count small, narrow areas during low water when the shorebirds were dispersed on their feeding grounds. The counts were obtained mainly by experienced amateur birdwatchers but some data were provided by professional ornithologists. To obtain fully coordinated counts a series of regional organizers were appointed, and for each complex there was a local count organizer who dealt directly with the individual observers, up to 30 of whom were involved

[1] British Trust for Ornithology, Beech Grove, Tring, Herts., England.

in counting a major estuary. In this way it was possible to ensure as complete coverage as possible in every month.

The accuracy of the estimates made by all counters, almost 1000 of whom have participated, could not be measured. Checks have been made in two of the important areas: Morecambe Bay (Wilson 1971) and the Ribble (Hale 1974). They measured both the accuracy and consistency of the counts by comparing aerial and ground photographs with numbers observed at the same time. Counters have a tendency to consistently underestimate shorebird flocks. For the larger species and flocks of less than 1000 of the smaller species the estimate was low by 5–10%. Large flocks of smaller species, mainly *Calidris* sp., may be underestimated by up to 25%; however, because the period of observation averaged 2–3 hours, the observer was able to either count small flocks joining or leaving a roost and was rarely confronted with very large flocks. The other potential source of error was the failure to locate all birds within the area. On a few occasions this clearly formed a major source of error, but once the observer has covered the counting area for a season (10–12 counts) all roost sites will have been located.

Now that data for six years have been obtained, a detailed assessment of each site is being made and the number of counts reduced to three each winter (December, January, and February) to monitor annual changes in the numbers and distribution of shorebirds.

International Counts

Since 1966 the I.W.R.B. counts of shorebirds have been organized in a way similar to the counts of the 'Birds of Estuaries Enquiry.' Each country in northwestern Europe has a national organizer and regional teams of observers. The counts made in Ireland by the Irish Wildbird Conservancy closely followed the British program but the international counts elsewhere were carried out only in January, although partial data were also obtained during August/September and April/May. In January expeditions visited other countries in southern Europe, Africa and Asia where there were no counting organizations. The aims of the international counts were twofold: firstly, they provided an estimate of the total population and distribution of each species of shorebird, from which could be obtained an objective assessment of the importance of each area. Secondly, the regular midwinter counts provided a method of monitoring the fluctuations of each species. The international counts are continuing both with regular European counts and expeditions visiting further unworked regions.

Banding Data

Census information can be greatly enhanced in value by combining it with banding data. This is clearly true in migration studies: Results from banding activities provide data on the breeding populations involved, on the use made of each area by different components of each population, and on the mobility characteristics of each species. These are all aspects which provide a more accurate conservation assessment at both site and species levels.

Since 1967 banding data (age, molt, measurements, weights, recoveries, and retraps) have been obtained from a large number of shorebirds. Up to the end of 1975 almost 500,000 shorebirds have been banded in Britain and Ireland and currently between 30,000 and 40,000 are banded annually. Over 10,000 individuals of seven species of shore waders (Dunlin *Calidris alpina*, Oystercatcher *Haematopus ostralegus*, Knot *C. canutus*, Redshank *Tringa totanus*, Ringed Plover *Charadrius hiaticula*, Curlew *Numenius arquata* and Sanderling *C. alba*) have been banded. In the rest of Europe large numbers have also been banded. In 1970 the British Trust for Ornithology set up the Wader Study Group to help liason between banders in Britain and elsewhere and to encourage further studies. By helping cooperative effort and by aiding special expeditions to catch shorebirds in other countries, from Greenland and Norway south to Mauritania, it has been possible to interpret data gathered in northwest Europe.

RESULTS

The six years of counts have provided much information. It is not intended in this review paper to describe them all in detail but to illustrate some of the results arising from extensive and intensive counts. The principal examples will be drawn from the counts of the Knot, the European wintering population of which breeds in northern Greenland and northeast Canada.

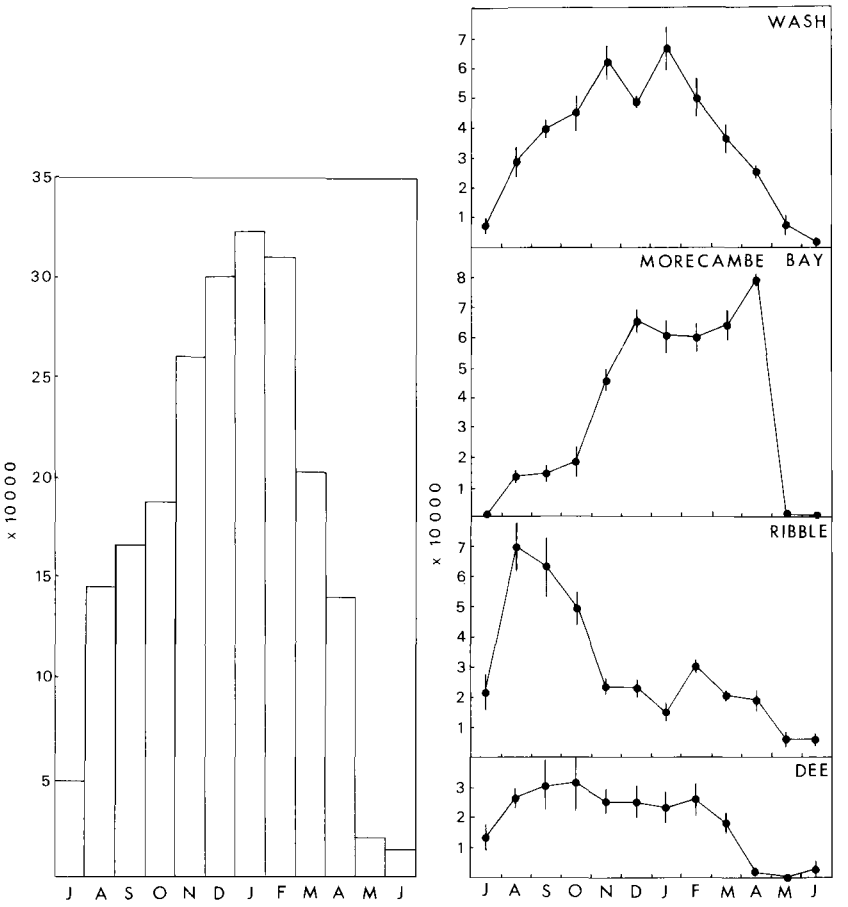

FIGURE 1. Left: Average number of Knot in each month in Britain and Ireland. Based on summation of average monthly counts in each estuary 1969–75. Right: Number of Knot in each month on the principal British estuaries. Filled circles, mean numbers; vertical bars, standard errors; based on 3–6 counts.

Number on Each Estuary

There are always small variations in the extent of coverage between years due to adverse weather conditions or illness or changes in the circumstances of observers; this precluded, in this study, a simple averaging of the annual monthly counts to provide a national picture. Instead the occurrence of the Knot on a national level (Fig. 1) has been obtained from the summation of the average monthly counts for each wetland.

The average counts of Knot from the four most important estuaries are also presented in Figure 1. Although the standard error is usually 10–20% of the mean, this might be expected in high arctic species which have considerable annual fluctuations in numbers. For example, in winter, at the time of maximum counts, the total numbers of Knot counted varied between 423,000 in 1971–72 to 237,000 in 1974–75.

Of particular note is that, even on major areas for a species, the pattern of

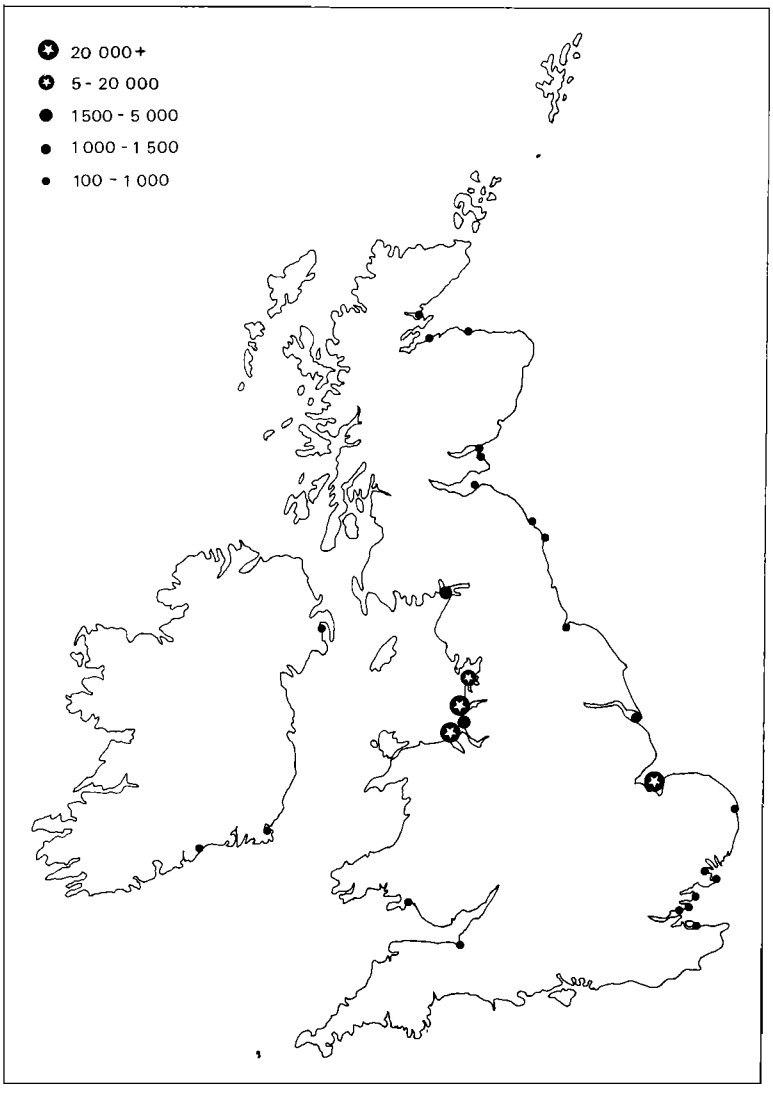

FIGURE 2. Distribution of Knot in Britain and Ireland in autumn. Based on average numbers present in August/September. Circles with stars are estuaries of international importance, larger filled circles are national importance (during autumn), smaller filled circles are of regional or local importance.

occurrence may neither follow a similar form nor correspond to the national picture. In a study in Essex, significant correlations have been found between numbers counted and biomass of preferred foods in each estuary (Goss-Custard et al., 1977). These highlight the value of and the need for the extensive collection of data.

The numbers counted in each month on each estuary or in the whole country provide, when compared with similar data for other regions, a picture of the migration pattern of the species. In Britain there is a rapid build-up of Knot in autumn, then the adult birds molt and numbers are relatively stable until this

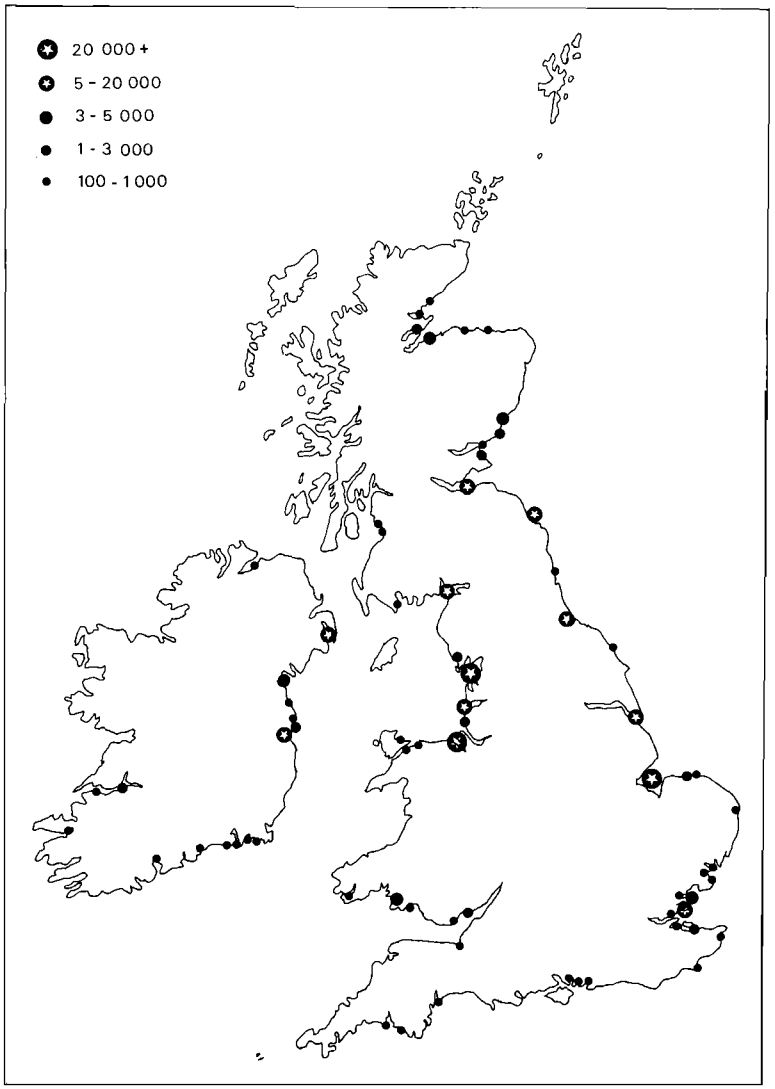

FIGURE 3. Distribution of Knot in Britain and Ireland in winter. Based on average numbers present in January. Symbols as Figure 3 but note level of national importance differs as more birds are present.

has been completed by mid-October; after that numbers rise quickly to a mid-winter peak. The peak in Britain and Ireland corresponds to a trough in numbers in the Waddensea (Denmark, Federal Republic of Germany, Netherlands) (Prater 1974).

National Distribution

The national distribution of each species can be illustrated in several ways, but perhaps a simple map is the clearest method of presenting the information, especially if it is aimed at environmental planning authorities. If monthly counts

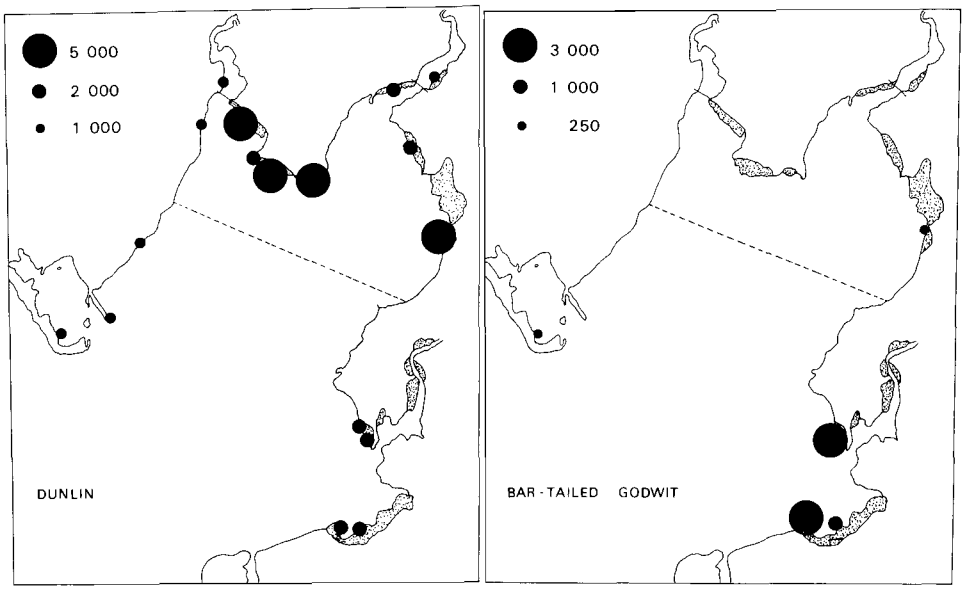

FIGURE 4. Distribution of Dunlin and Bar-tailed Godwit in Morecambe Bay in relation to a proposed barrage (dotted line). Salt marshes are stippled.

have been made the changes in distribution with season can be demonstrated. Figures 2 and 3 present the distribution of Knot in autumn and winter in Britain and Ireland. In September, when adults are molting, the species is found in only a few major estuaries but with the influx in winter there is a rapid increase in numbers in other estuaries.

Distribution within Each Estuary

The distribution of shorebirds within each estuary was also mapped. Where possible, feeding grounds were noted by the observers. The roost sites changed with the tidal cycle. On neap tides shorebirds formed roosts near to their feeding grounds; these were also usually used as subroosts during the spring tides. The numbers of each species of shorebird were obtained separately for each roost. Thus it was possible to map the distribution of each species in detail. This information was essential for the detailed assessment of the possible impact of estuarine developments. Figure 4 shows the distribution of Dunlin and Bar-tailed Godwit *Limosa lapponica* in Morecambe Bay (from Wilson 1971) and the position of a proposed barrage [dam] across the estuary. The latter species would be little affected but the feeding grounds of 31,000 out of 42,000 Dunlin would be lost. On the Wash, Goss-Custard (1977) has used count data with detailed observations to assess the relative impact of different sites for a proposed reservoir.

Changes in Numbers

Shorebird numbers are not static. They change annually due to factors which appear to be linked to climatic variations. In Britain severe winters have caused high mortality (Dobinson and Richards 1964) but no prolonged cold weather has occurred since 1969 when shorebird counts started. Raptor predation appears to

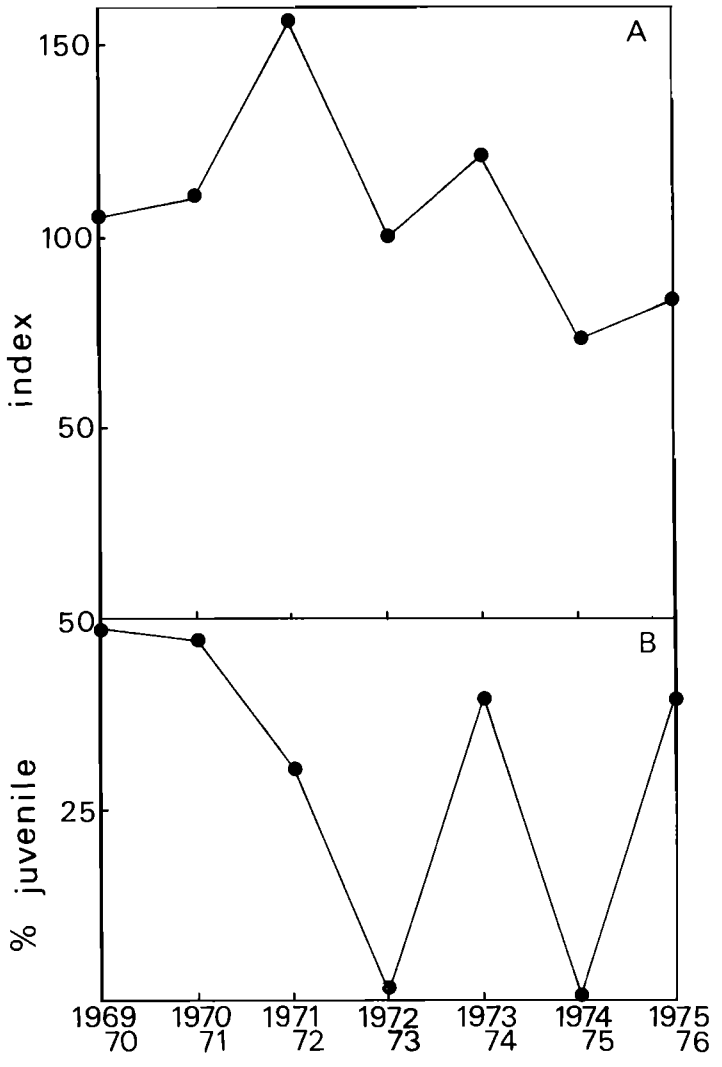

FIGURE 5. Relative changes in the number of Knot wintering in Britain and Ireland and percentage of juvenile Pale-bellied Brent Geese wintering in Ireland.

be unimportant in Britain, unlike the situation in California (Page and Whitacre 1975), and most shorebirds have been fully protected from hunting since 1954. The changes in numbers of Knot are presented in Figure 5. The index was calculated using paired samples and relating them to a standard year; 1972–73 was chosen as it was the second winter with full coverage. A considerable variation is shown from 155 in 1971–72 to 74 in 1974–75. The index is compared in Figure 5 with the breeding success of the Light-bellied Brent Goose *Branta bernicla hrota* as observed by winter age ratios in Ireland (data from the annual goose reports in 'Wildfowl'). This species breeds in a similar zone to the Knot. Barry (1962) has described the effect of late spring/summer weather conditions on this species. In some years breeding may not take place. It is assumed that broadly

TABLE 1
PERCENTAGE OF FIRST WINTER KNOT IN THE TWO REGIONS OF MORECAMBE BAY

Winter (Nov–March)	Walney/Keer/Lune			Kent/Leven		
	Adult	IW[a]	%IW	Adult	IW	%IW
1968–69	3495	175	4.8	47	23	32.9
1969–70	1894	132	6.5	156	334	68.2
1970–71	432	22	4.8	294	50	17.0
1971–72	126	3	2.3		ND[b]	
1972–73	354	20	5.3	1031	168	14.0
1973–74	90	2	2.2		ND	
TOTAL	6391	354	5.2	1528	575	27.3

[a] IW, first winter.
[b] ND, no data.

similar conditions will affect the Knot, although the precise effect will be slightly different. There is a close agreement between breeding success of Brent and the trends in the winter numbers of Knot with sharp decreases occurring in the two winters (1972–73 and 1974–75) which were preceded by very poor Brent breeding seasons. During this period the number of Knot wintering in France has also decreased from an estimated 100,000 to 10,000 and in the Waddensea from 70,000 to 40,000.

Unfortunately no long-term shorebird census data are available, so the changes observed recently can not be placed fully in context. In Britain there are many local societies which have published detailed bird records since the 1930's. The Black-tailed Godwit *Limosa limosa* (the subspecies occurring in Britain is *L. l. islandica*) was rare in winter in the early years and a fairly complete record exists of its changes in numbers. Prater (1975) showed that there was a slow increase in numbers; there were less than 20 in 1931–35, 310 in 1941–45, 1440 in 1951–55, 3200 in 1961–65 and 3730 in 1971–75. There were some indications that a peak occurred about 1970 and numbers may now be declining slightly. This increase corresponded to the climatic amelioration and spread to new breeding areas in Iceland (Gudmundsson 1951). Both long- and short-term trends in numbers are no doubt continuing and this means that population estimates and hence criteria of international and national importance have to be revised periodically (see Discussion).

INTERPRETIVE STUDIES

The inclusion of banding with census data provides a much more precise understanding of the role that each wetland plays in the life cycle of the species. In particular it provides the age, sex, race, and molt status of the species. The weight changes may indicate when an increased food demand occurs, and the pattern of retraps (birds found on the same estuary) and recoveries (birds found elsewhere) may give a measure of the mobility of the species.

There is little information on the distribution of sexes of shorebirds in Britain. However, virtually all of the Ruff *Philomachus pugnax* wintering in Britain are males, whereas in South Africa about 90% are females (Schmitt and Whitehouse, 1976). Further examples may be found in future studies.

The difference in timing of adult and juvenile migration periods is well known but there are many other examples of age segregation in shorebirds. Table 1 presents the winter data for Knot in Morecambe Bay. This period was chosen to

eliminate biases arising from the trapping of flocks of juveniles during the autumn migration. Observations of movements enabled five subdivisions of the area to be made. Three of these have a very low percentage of first winter birds (Walney 4.7%, Keer 5.4%, Lune 4.0%) whereas the two areas in the north of Morecambe Bay had much higher percentages (Leven 27.1%, Kent 32.9%). These differences were consistent in successive years.

Racial or population discrimination is also an important aspect of shorebird studies. Much work is in progress at present on geographical variation, using both biometrics and plumage characters. Once the passage and wintering areas of each population are known, or the percentage contribution of each where overlap occurs, the counts provide an estimate of that population. Dick et al. (1976), using bill measurements, showed that the African wintering Knot breed in the USSR while the west European birds breed in Greenland and Canada. The effect of development schemes would be felt to different degrees by different populations.

Other studies are being made on the mobility characteristics of each species of shorebird. All species studied show a high specificity to estuary in successive years and also to site within each estuary within a single winter. There are, however, differences between species. The same winter movements of two species have been studied in Morecambe Bay. Preliminary studies, based on the proportion of available birds retrapped from a series of large catches all around the estuary, indicate that although the Knot is more likely to remain in a single area throughout the winter, up to 20–40% may move away. Dunlin is much more site specific and only a single bird was retrapped away from the ringing site. A similar pattern appears to be shown for successive years. On the Wash the Knot and Oystercatcher are the species which are least site specific and it is possible that this behavior has been evolved to exploit the relatively variable food source of bivalve molluscs which do not have a constant settlement pattern.

DISCUSSION

The main aim of the 'Birds of Estuaries Enquiry' was to provide a conservation assessment of all estuaries. I.W.R.B. counts provided an estimate of the total population of each species found in Europe and North Africa (Prater 1977). At the 5th International Conference on the Conservation of Wetlands and Waterfowl, Heiligenhafen 1974, the governmental delegates agreed that a site was of international importance if it supported 1% or more of the total flyway population (here it refers to the Atlantic coast of Europe and northwest Africa) of any species of shorebird. This should only be used if the numbers exceed 10,000, so that 1% is 100 or more. The total number of Knot of this flyway is about 600,000 and using the 1% criterion for this species, the Wash and Ribble estuaries are of importance from July to May, the Dee from July to March and Morecambe Bay from August to April. These four estuaries supported between 21.2% and 28.2% of the flyway population of Knot between August and April. Similar calculations can be made for other species which occur.

The 1% criterion can be used throughout the year if the species winters almost completely within the area covered by the January counts. Counts made during spring or autumn migration can, if carefully designed, also provide total population estimates for species wintering wholly or partly outside the winter census area.

There are several other criteria of international importance which apply to waterbird populations. Total shorebird numbers of 20,000 or more at one site is also considered to represent a figure of international importance. Special rarity criteria should be used if the flyway numbers are less than 10,000. Most other criteria relate to the wetland, whether it is unique, representative, or an important research area.

The numerical criteria do not necessarily relate to the survival of the species, as many other factors interact to affect this, but they do highlight the sites where significant numbers of birds occur and where loss of habitat would have a noticeable effect. All numerical criteria need to be constantly revised as there are changes in the overall population numbers.

It is possible and probably desirable to use similar criteria on a national scale to show which estuaries are of the next level of importance. In Britain 1% and 10,000 are those accepted; the 10,000 is, like the 20,000 international, probably the less useful criterion as it does not take into account the species involved. Because monthly estimates have been made in Britain it is feasible to assess the importance of each site on a national basis throughout the year.

ACKNOWLEDGMENTS

The information presented in this paper was obtained by the efforts of about 2000 observers and banders throughout Europe; it is to them that the greatest thanks must go. I would also like to thank my colleagues, in particular Dr. L. A. Batten, Dr. J. D. Goss-Custard, and J. Parslow for their continuing help and advice. The survey was financed by a grant from the Nature Conservancy Council.

LITERATURE CITED

BARRY, T. W. 1962. Effect of late seasons on Atlantic Brent reproduction. J. Wildl. Mgmt. 26:19–26.

DICK, W. J. A., M. W. PIENKOWSKI, M. WALTNER, AND C. D. T. MINTON. 1976. Distribution and geographical origins of Knot *Calidris canutus* wintering in Europe and Africa. Ardea 64:22–47.

DOBINSON, H. M., AND A. J. RICHARDS. 1964. The effects of the severe winter of 1962/63 on birds in Britain. Brit. Birds 57:373–435.

GOSS-CUSTARD, J. D. 1977. The ecology of the Wash. III. Density-related behaviour and the possible effects of a loss of feeding grounds on wading birds (Charadrii). J. Appl. Ecol. 14:721–739.

GOSS-CUSTARD, J. D., D. G. KAY, AND R. M. BLINDELL. 1977. The density of migratory and overwintering Redshank *Tringa totanus* (L.) and Curlew *Numenius arquata* (L.), in relation to the density of their prey in south-east England. Est. Coast. Mar. Sci. 5:497–510.

GUDMUNDSSON, F. 1951. The effects of the recent climatic changes on the bird life of Iceland. Proc. Xth Int. Ornithol. Congr. Uppsala:502–514.

HALE, W. G. 1974. Aerial counting of waders. Ibis 116:412.

PAGE, G., AND D. F. WHITACRE. 1975. Raptor predation on wintering shorebirds. Condor 77:73–83.

PRATER, A. J. 1974. The population and migration of Knot in Europe. Proc. I.W.R.B. Wader Symp. Warsaw 1973:99–113.

PRATER, A. J. 1975. The wintering population of the Black-tailed Godwit. Bird Study 22:169–176.

PRATER, A. J. 1977. The distribution of coastal waders in Europe and North Africa. Proc. Int. Conf. Conservation of Wetlands and Waterfowl, Heiligenhafen 1974:255–271.

SCHMITT, M. B., AND P. J. WHITEHOUSE. 1976. Moult and mensural data of Ruff on the Witwatersrand. Ostrich 47:179–190.

WILSON, J. 1971. The numbers, distribution and movements of waders in Morecambe Bay. Morecambe Bay Barrage Feasibility Study. Water Resources Board Report on Biology, Appendix C (mimeographed).