THE TIMING OF AUTUMN MIGRATION OF SOME WADER SPECIES IN INLAND EUROPE: PROVISIONAL RESULTS

OAG Münster

Third progress report of the WSG inland wader counts project

The inland wader count project was started in 1979. Its aims are to study the migration phenology, habitat selection and population fluctuations of a number of wader species that are regularly found in European inland habitats. So far 216 sites in 13 European countries have been involved in the project (Figure 1). The aims and methods of the project were described in detail in previous reports (OAG Münster 1981, 1982). The purpose of this paper is to present some preliminary results of the studies of migration phenology, based on the material gathered from 1979 to 1985. The results are preliminary, firstly because not all data which are available could yet be incorporated, and because some of the findings are presented in a rather crude way, and will need some methodological refinement in their final. Nevertheless we hope that this paper will form the basis for future discussions and analyses.

The project investigates the timing of autumn migration of typical inland wader species, and the geographical variation in this timing. Migration patterns determined by counting waders at a single site have been published for various places (Bauer, Kliebe, Sartor and Wehner 1968, Bezzel and Wust 1965, Harengerd, Prunte and Speckmann 1973, Mason 1984). The data used in these studies ranged from circumstantial observations to regular complete daily counts. The means of presentation of the data varied considerably, so that a direct comparison of the results is difficult. Furthermore, migration patterns from a single site can reflect the changing ecological parameters at that site, rather than the migration pattern of a given species in that region. Even sites in the same geographical area, but with different habitats (e.g. wet meadows, sewage farms, gravel pits) may show completely different timings of migration (OAG Munster 1982) so that using just one site in an area can be misleading for predictions of the true migration phenology of a species. We could do this because almost all contributors have used the same counting methods over the same period of time, and we have been able to combine data from several sites in most areas. For the first time it is possible to present data on migration phenology for the whole of Central and Western Europe.

METHODS

The waders on most of the sites used in the project were counted at least once a week. For the 100 sites listed in Figure 1, a complete

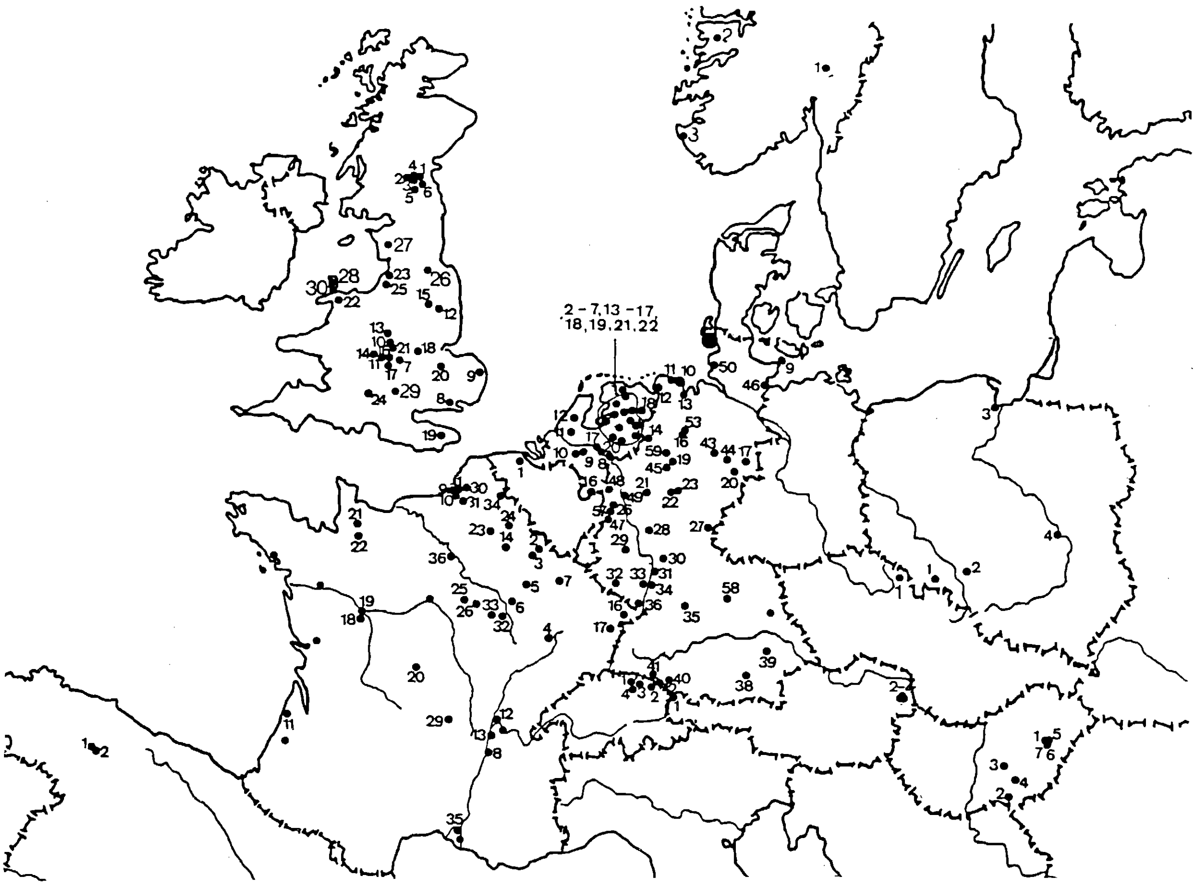

Figure 1. Counting sites of Inland Wader Counts.

series of counts were available from 1979 to 1985. "Complete" means that there is at least one count in each of the five day periods (see Flegg and Zink 1973 for the reasons for using this period), during the autumn migration period. Most data from the Camargue are from 1972-1974. The area in which complete counts were available (report area) was divided into grid squares of four degrees of longitude and two degrees of latitude. All the data within a grid square were combined as follows. First, for each species and each site the mean numbers of resting birds were calculated (total of birds counted divided by the number of visits). Secondly, for each species the means for all sites in the grid square were added. The resulting frequency distribution was the basis for the final step of calculating the median. These medians, used as parameters for the timing of the migration, are shown for all species in Figures 2-27. The date shown in these figures is the mid-date of the 5-day period into which the median falls. Medians based on very few observations were omitted. 15 June was taken as the start, and the 30 November as the end of the autumn migration period. Statistical methods were taken from Sachs (1978). Regression lines shown in the figures are significant at $P<0.05$.

Some of the species breed or winter, as well as being passage migrants in the report area. Breeding birds and wintering birds could not always be separated clearly from migrants. Indication of the influence of local breeders or wintering birds are mentioned in the species accounts. The species included in this paper are those for which we have most data available. The Little Ringed Plover *Charadrius dubius* had to be excluded from the analysis because numbers of breeding birds seemed to exceed migrants at most sites.

RESULTS

Ringed Plover *Charadrius hiaticula* (Figure 2)

Ringed Plovers breed on coastal parts of the regions surveyed by the project. Inland they are found only during the migration periods. The counts on and near the coasts are certainly influenced by the presence of breeding birds, but not to a great extent, since the numbers of breeding pairs at the counting sites were small. Few wintering birds were found at the

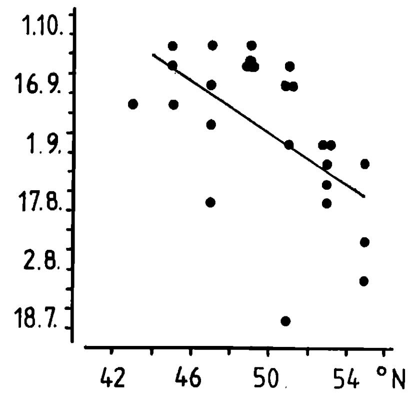

Figure 3. The relationship between the median date of autumn migration of Ringed Plover and latitude.

counting sites, so that the data represented in Figure 2 refer mainly to migrating birds. The geographical distribution of medians shows two trends. Firstly, at sites near the coast migration generally occurs earlier than inland, probably because of the higher ratio of adults to juveniles on the coast, combined with the early start of adult migration (Glutz, Bauer and Bezzel 1975, and own data). In contrast to the situation at the coast, the numbers of birds inland are not significant and are mainly late-migrating juveniles (Harengerd, Prunte and Speckmann 1973). Secondly, the peak of migration occurs progressively later further south (Figure 3), a feature that is apparent on the coast as well as inland. There is no such trend in the timing of the migration east-west.

Grey Plover *Pluvialis squatarola* (Figure 4)

Grey Plovers winter on central and western European coasts. Especially in south western France these wintering populations have produced a very late median in that region. The overall picture is not very uniform: it shows some remarkably early dates and a peak of migration at most of the inland sites in October, but few Grey Plovers occur inland, so median dates are based mostly on small samples (exceptions being Camargue, south western France and German North Sea coast). In any case, no trends in the distribution of medians could be found.

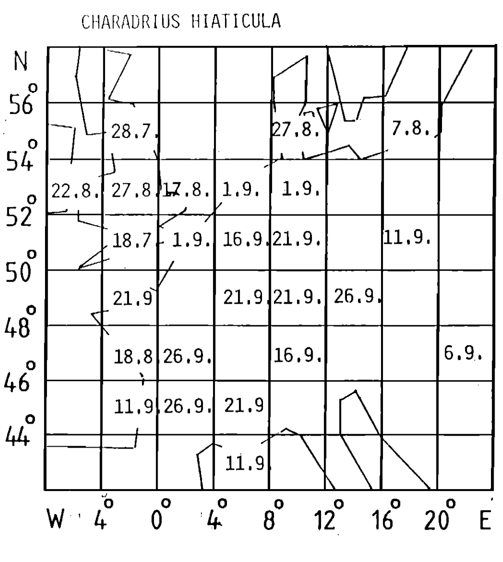

Figure 2. Median dates for the autumn (day-month) migration of Ringed Plovers.

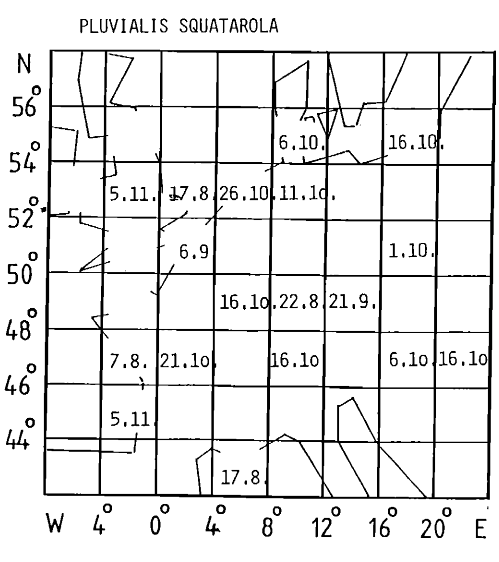

Figure 4. Median dates for the autumn migration of Grey Plovers.

Lapwing *Vanellus vanellus* (Figure 5)

Despite a great amount of data, the median dates for Lapwing give an inconclusive picture. No trends are visible, and the medians for neighbouring grid squares differ by months in some cases. The influence of breeding (in or near most of the sites) and wintering (in the western part of the report area) birds on the results is greater than for any other species. Results are hard to interpret also because Lapwings have a complicated migration system including pre-summer migration and population-specific migration patterns (Imboden 1974). Additionally, the resting sites involved in the inland wader counts are often visited by Lapwings only sporadically, because the main resting and feeding sites are fields and meadows - habitats that have not yet been included in the programme on a large scale. Eventually more detailed methods may produce some clearer results.

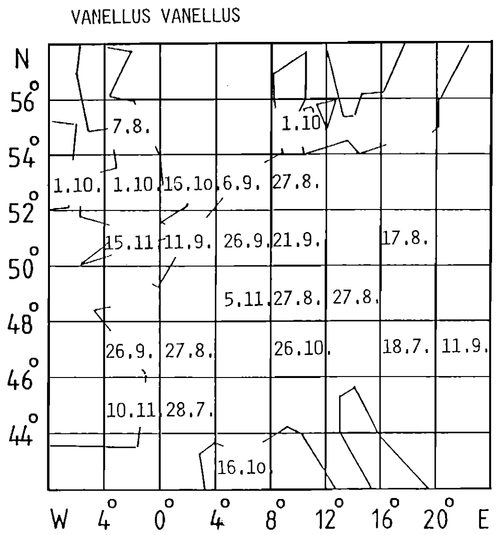

Figure 5. Median dates for the autumn migration of Lapwings.

Knot *Calidris canutus* (Figure 6)

Like Grey Plovers, many Knots spend the winter on western European coasts. Outside the breeding season Knots are typical coastal waders. Large numbers of wintering birds were found at counting sites only in south western France. Inland only a few, mostly juvenile

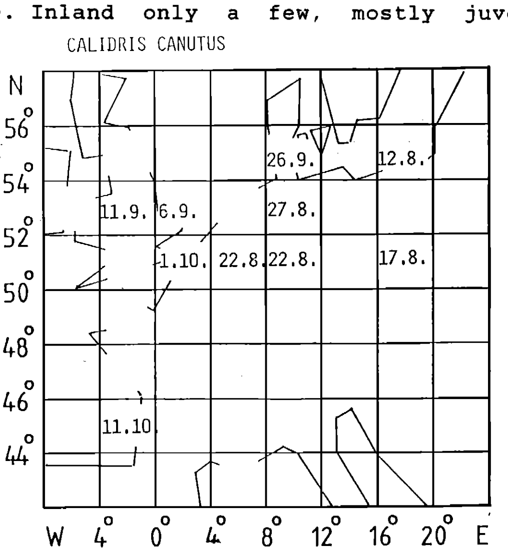

Figure 6. Median dates for the autumn migration of Knots.

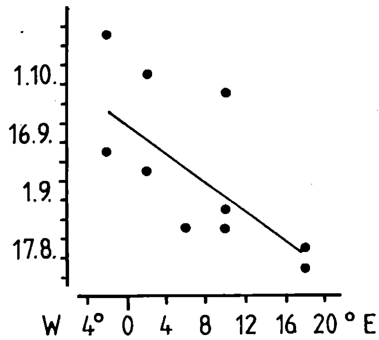

Figure 7. The relationship between the median date of autumn migration of Knots and longitude.

birds occur, mostly in the northern part of the report area. Hence counting data from inland sites are quite scarce. However, the data show a significant east-west trend for the inland sites as well as for the coastal sites (Figure 7). There was no north-south trend.

Little Stint *Calidris minuta* (Figure 8)

Little Stints are almost entirely migrants in central and western Europe. Only in south-western France, at one counting site (Parc Ornithologique du Teich) were some winterers found. Most of the inland birds in autumn are juveniles (pers. obs.). With a few exceptions the medians lie closely together and geographical trends are not apparent: Little Stints migrate everywhere in the report area at about the same time.

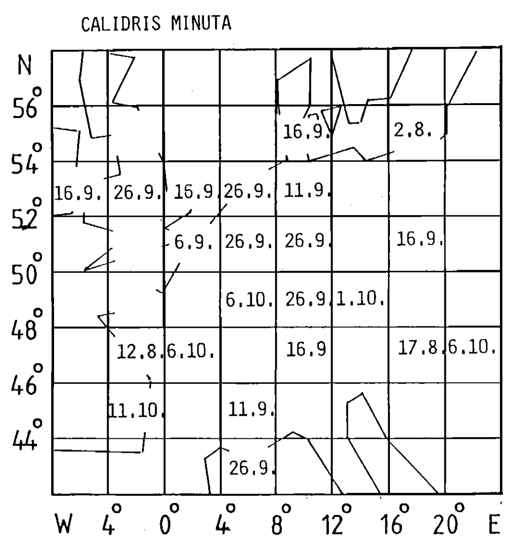

Figure 8. Median dates for the autumn migration of Little Stints.

Curlew Sandpiper *Calidris ferruginea* (Figure 9)

Like Little Stints, those Curlew Sandpipers found during autumn migration in Europe are mostly juveniles. In some years they form invasions (Stanley and Minton 1972, Moser 1985, OAG Münster 1983). Curlew Sandpipers are entirely migrant in the report area. The distribution of their medians over central and western Europe shows a pattern similar to that of the Knot (Figures 6 and 7). Migration is later in the east than in the west (Figure 10) but there are no north-south differences.

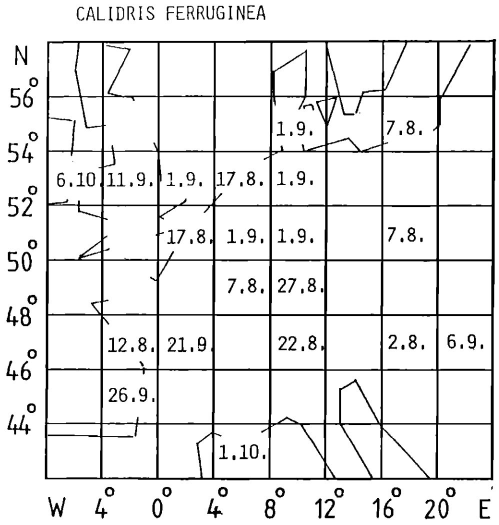

Figure 9. Median dates for the autumn migration of Curlew Sandpipers.

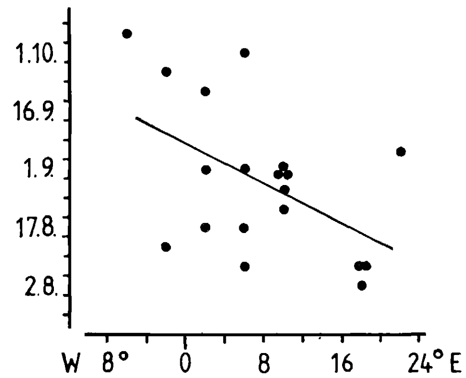

Figure 10. The relationship between the median date of autumn migration of Curlew Sandpipers and longitude.

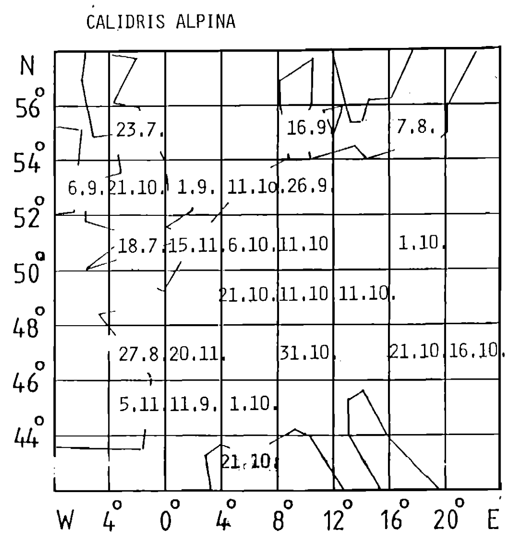

Figure 11. Median dates for the autumn migration of Dunlins.

Dunlin *Calidris alpina* (Figure 11)

Dunlins breed in low numbers in the counting region, but winter in high numbers on western European coastlines. Among the counting sites again the Parc Ornithologique du Teich in south-western France has mostly overwintering birds. The medians differ considerably between the regions, and as for Ringed Plover they show two trends. Firstly, medians seem to be earlier near the coast than inland. Secondly, timing of migration is delayed from the north to the south (Figure 12), but not from the east to the west. Juveniles generally migrate later than their adult conspecifics (Glutz von Blotzheim *et al.* 1975, OAG Münster 1976): the late medians inland will again result from the high proportion of juveniles at these sites. The variable timing for the coastal sites may be a consequence of the different migration periods of different geographical populations which meet at western European coastlines.

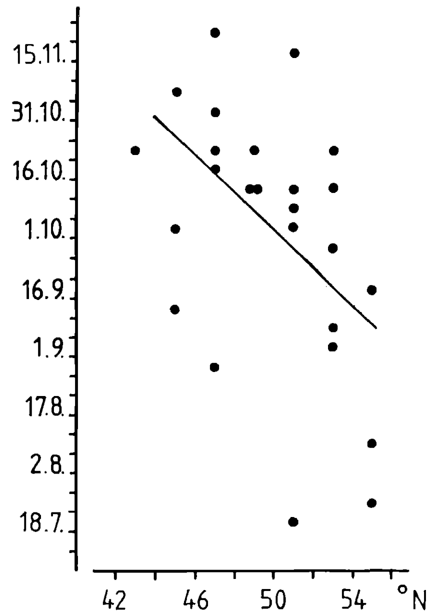

Figure 12. The relationship between the median dates of autumn migration of Dunlins and latitude.

Ruff *Philomachus pugnax* (Figure 13)

Ruffs no longer breed in large numbers in the report area. Some Ruffs spend the winter in Great Britain and thus influence the quite late median migration dates in this country. Timing of migration of Ruffs is very early in the eastern, north eastern and southern parts of the area. In western and central Europe

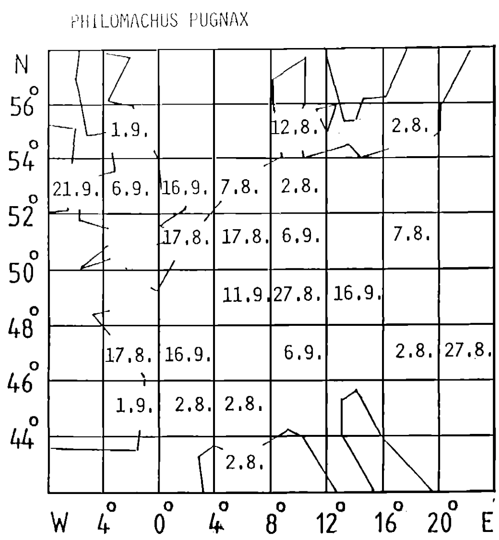

Figure 13. Median dates for the autumn migration of Ruffs.

migration peaks occur later. It is possible that, as for the *Calidris* species there is a relationship between the timing of migration and the age ratios in the different regions. Timing of migration will also be affected by the presence of moulting birds in some areas, but more information is needed for the location of moulting sites. There were no north-south or east-west trends in migration timing.

Common Snipe *Gallinago gallinago* (Figure 14)

This species breeds, usually in low numbers, at or near some of the counting sites, especially those in the northern part of the report area. Snipes winter in the western part of the report area: the median dates are affected by the presence of wintering birds especially in Great Britain and western France. The medians differ greatly and do not show any uniform trend. The data indicate only a possible delay in the timing of migration in north-south direction, but the trend is not statistically significant (Figure 15).

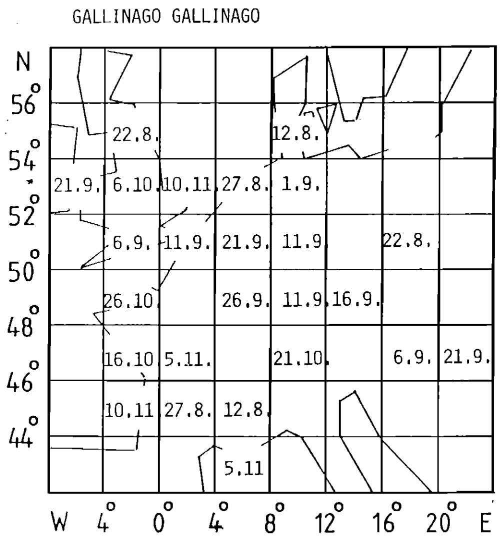

Figure 14. Median dates for the autumn migration of Snipes.

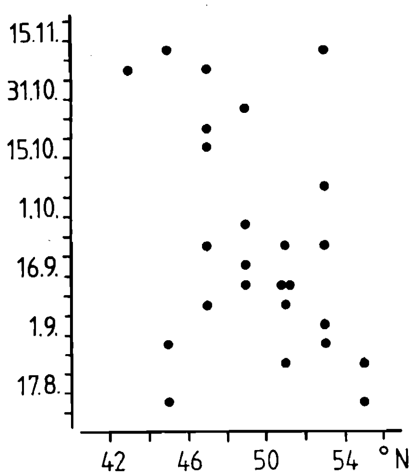

Figure 15. The relationship between the median dates of autumn migration of Snipes and latitude.

Black-tailed Godwit *Limosa limosa* (Figure 16)

The centre of the breeding distribution of this species, the Netherlands (Piersma 1987), lies completely within the report area. Wintering birds, mainly of the subspecies *islandica*, are found in Great Britain and western France. Significant numbers of Godwits at counting sites were reported from the Netherlands and northern Germany, where the comparatively early medians probably reflect post-breeding assemblies and moulting groups. Therefore these dates show start, rather than the peak, of migration. At both of the two large resting sites, the Camargue and the lowlands of Lower Austria and Hungary, medians are considerably later, which is also true for the other counting sites. These data probably represent the timing of migration more correctly. At the smaller sites the later dates are a result of the high percentage of late-migrating juveniles.

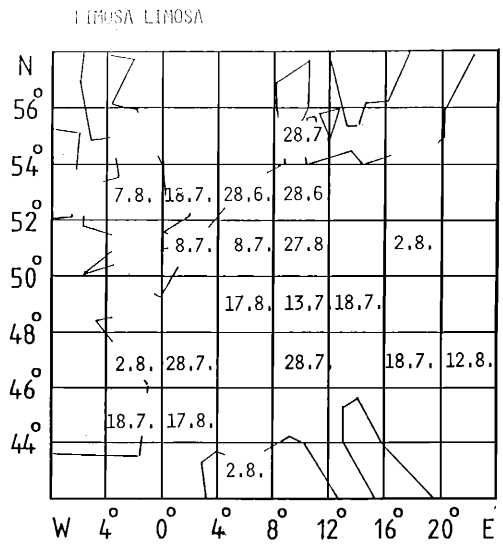

Figure 16. Median dates for the autumn migration of Black-tailed Godwits.

Bar-tailed Godwit *Limosa lapponica* (Figure 17)

Very few Bar-tailed Godwits rest at inland sites. Hence the medians are based on small amounts of data, and so preclude detailed analysis.

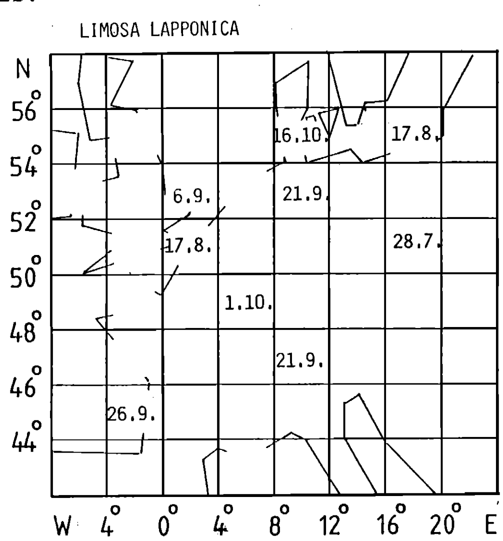

Figure 17. Median dates for the autumn migration of Bar-tailed Godwits.

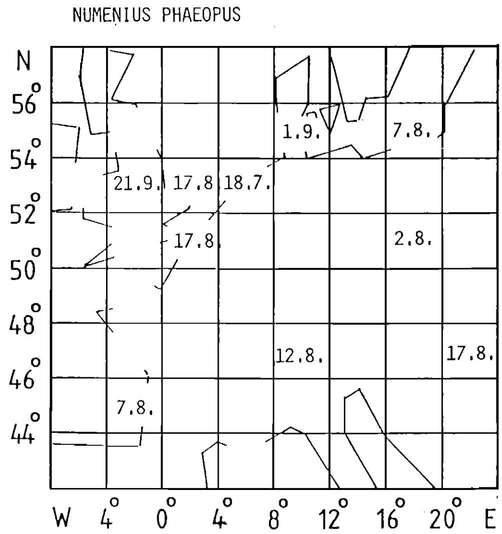

Figure 18. Median dates for the autumn migration of Whimbrels.

Whimbrel *Numenius phaeopus* (Figure 18)

Most of the Whimbrels were counted in the Netherlands, Hungary and south-western France, where migration peaks occur at about the same time. Elsewhere, the timing is hard to interpret due to the small amount of data.

Curlew *Numenius arquata* (Figure 19)

Similar problems of interpretation as those mentioned for the Whimbrel exist also for the Curlew - although for other reasons. Curlews breed near many of the counting sites, especially in the northern part of the report area, and they are wintering mainly at the coasts. The influence of breeding birds, which are the reason for the early medians in Scotland and near the Baltic coast in Poland, and of wintering birds, as well as the different migration strategies of different populations, make interpretation of the data presented here very difficult. Clear results may come only from more detailed studies.

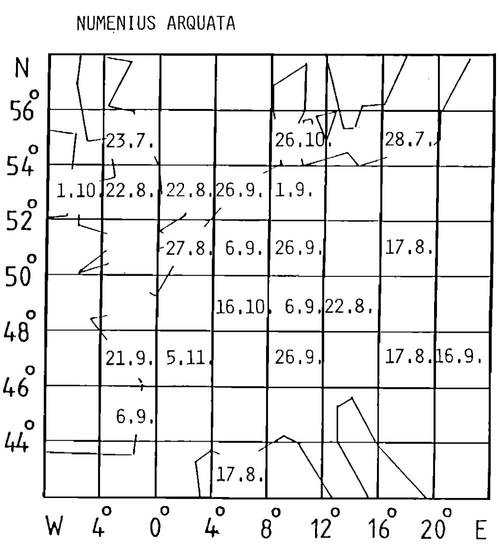

Figure 19. Median dates for the autumn migration of Curlews.

Spotted Redshank *Tringa erythropus* (Figure 20)

Spotted Redshanks do not breed in the report area, but do winter in small numbers. Birds arrive quite early in the Waddensea, in eastern France, near Lake Neusiedl in Austria and in the Camargue. The major concentrations of birds during autumn migration are found at these sites. The proportion of adults is probably high in these regions, although this has yet to be proved for each case (Glutz von Blotzheim *et al.* 1977). At the other inland sites the resting numbers, of mostly juvenile birds, are much lower, and the peaks of migration are later. There are no geographical trends in timing. All the median dates for this species are similar.

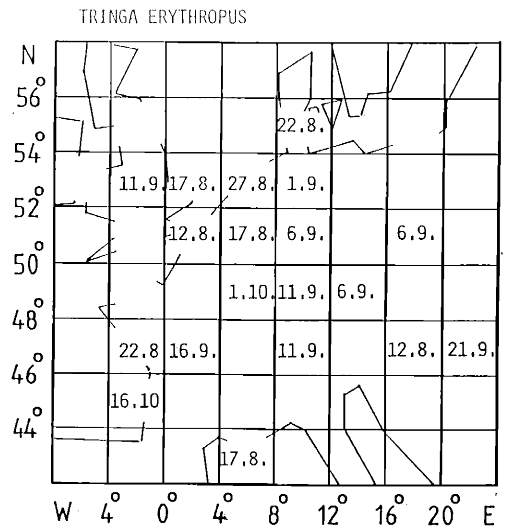

Figure 20. Median dates for the autumn migration of Spotted Redshanks.

Redshank *Tringa totanus* (Figure 21)

As for the Curlew the results for the Redshank are hard to interpret solely on the basis of count data. Breeding and wintering populations and the occurrence of different subspecies within the study region has resulted in an irregular pattern of the timing of migration in different regions. No trends could be detected.

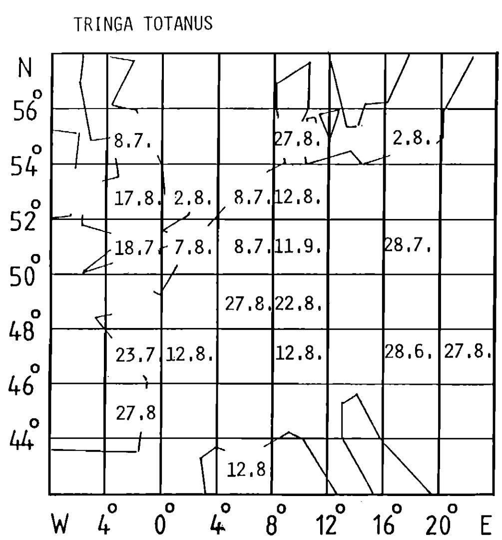

Figure 21. Median dates for the autumn migration of Redshanks.

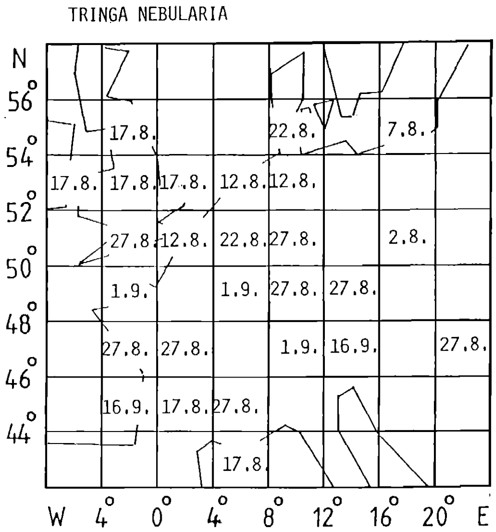

Figure 22. Median dates for the autumn migration of Greenshanks.

Greenshank *Tringa nebularia* (Figure 22)

Like Spotted Redshanks, Greenshanks do not breed, but do winter in small numbers, in the report area. Peak migration of Greenshanks occurs everywhere at about the same time in mid to late August. The medians in Poland, near the North-sea coast, and in the Camargue, seem to be slightly earlier than in inland central Europe. The influence of the distribution of age-classes on this pattern remains to be studied - juveniles are known to migrate later than adults (Cramp and Simmons 1983). There are no clear trends in the timing of migration.

Green Sandpiper *Tringa ochropus* (Figure 23)

There are hardly any differences in the timing of migration of Green Sandpipers: migration takes place simultaneously in central and western Europe in mid-August. The figures are not affected by birds breeding or wintering at the counting sites.

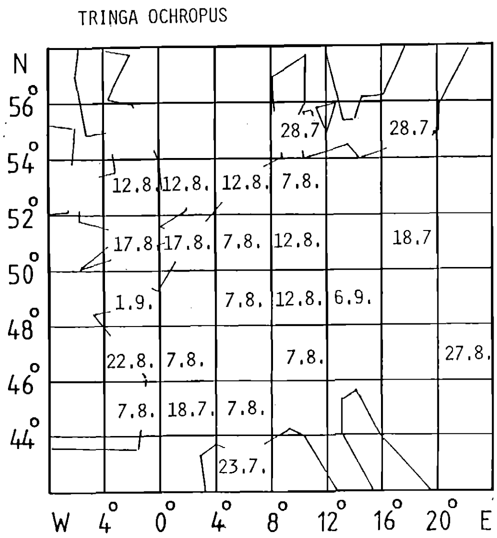

Figure 23. Median dates for the autumn migration of Green Sandpipers.

Wood Sandpiper *Tringa glareola* (Figure 24)

Wood Sandpipers neither breed nor winter in the report area. As for Green Sandpipers, the few differences between the median dates occur

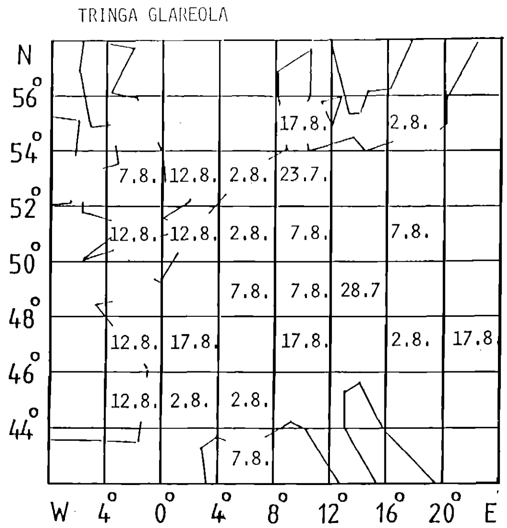

Figure 24. Median dates for the autumn migration of Wood Sandpipers.

independently of the geographical area. Peak migration through Europe is in mid- to late August.

Common Sandpiper *Actitis hypoleucos* (Figure 25)

Common Sandpipers also migrate through all regions at about the same time. The comparatively early dates in Scotland and Wales are post-breeding assemblies of local breeding birds, but even including these dates, there is no significant north-south trend in migration timing (Figure 26).

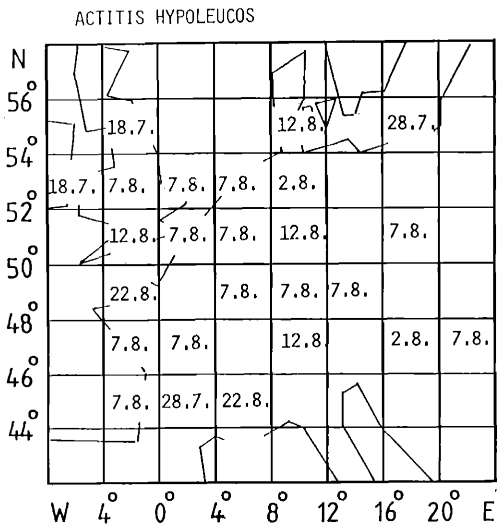

Figure 25. Median dates for the autumn migration of Common Sandpipers.

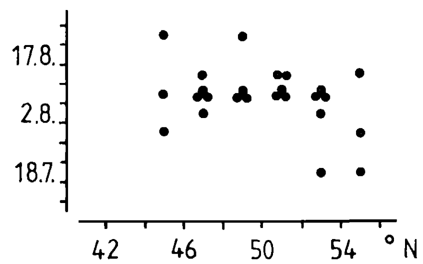

Figure 26. The relationship between the median dates of autumn migration of Common Sandpiper and latitude.

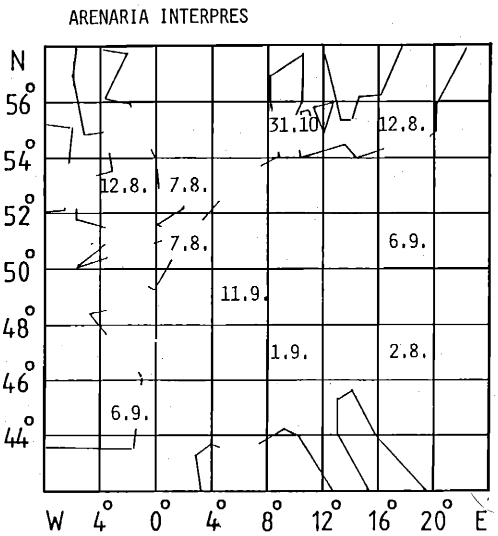

Figure 27. Median dates for the autumn migration of Turnstones.

Turnstone *Arenaria interpres* (Figure 27)

As for Bar-tailed Godwits, Turnstones may be found regularly on migration inland, but numbers are generally very low. Median dates vary greatly, but there is no clear geographical trend in the data.

DISCUSSION

The most surprising result of the studies so far is that only 4 of the 20 species described show significant latitudal or longitudal trends in their migration dates. For only 2 other species, Common Snipe and Common Sandpiper, there are possible, but non-significant trends. The findings for those species with very complex migration patterns (Lapwing, Curlew, Redshank), and for species which are scarce inland (Grey Plover, Bar-tailed Godwit and Turnstone) will need more refined methods of evaluation. They will have to be re-evaluated by using more material and refined methods. The medians for some typical inland species like Green Sandpiper, Wood Sandpiper and also Greenshank and Spotted Redshank, vary so little over the whole range of western and central Europe that it appears that these birds rest only once in this region during their autumn migration. This means that they must travel over quite long distances by non-stop flights. Using Wood Sandpipers as an example, the birds are theoretically able to do just this. Calculations of theoretical flight ranges based on the weights of the birds caught in the sewage farms of Munster, in northern West Germany, show that the fat deposits of these Wood Sandpipers are large enough for them to reach their winter quarters in western Africa by flying across the Mediterranean Sea and the Sahara without resting (Figure 28, OAG Münster in prep.). This ability to make long non-stop flights, which is probably possessed also by other species, may be one reason for the small number of waders seen at the counting sites,

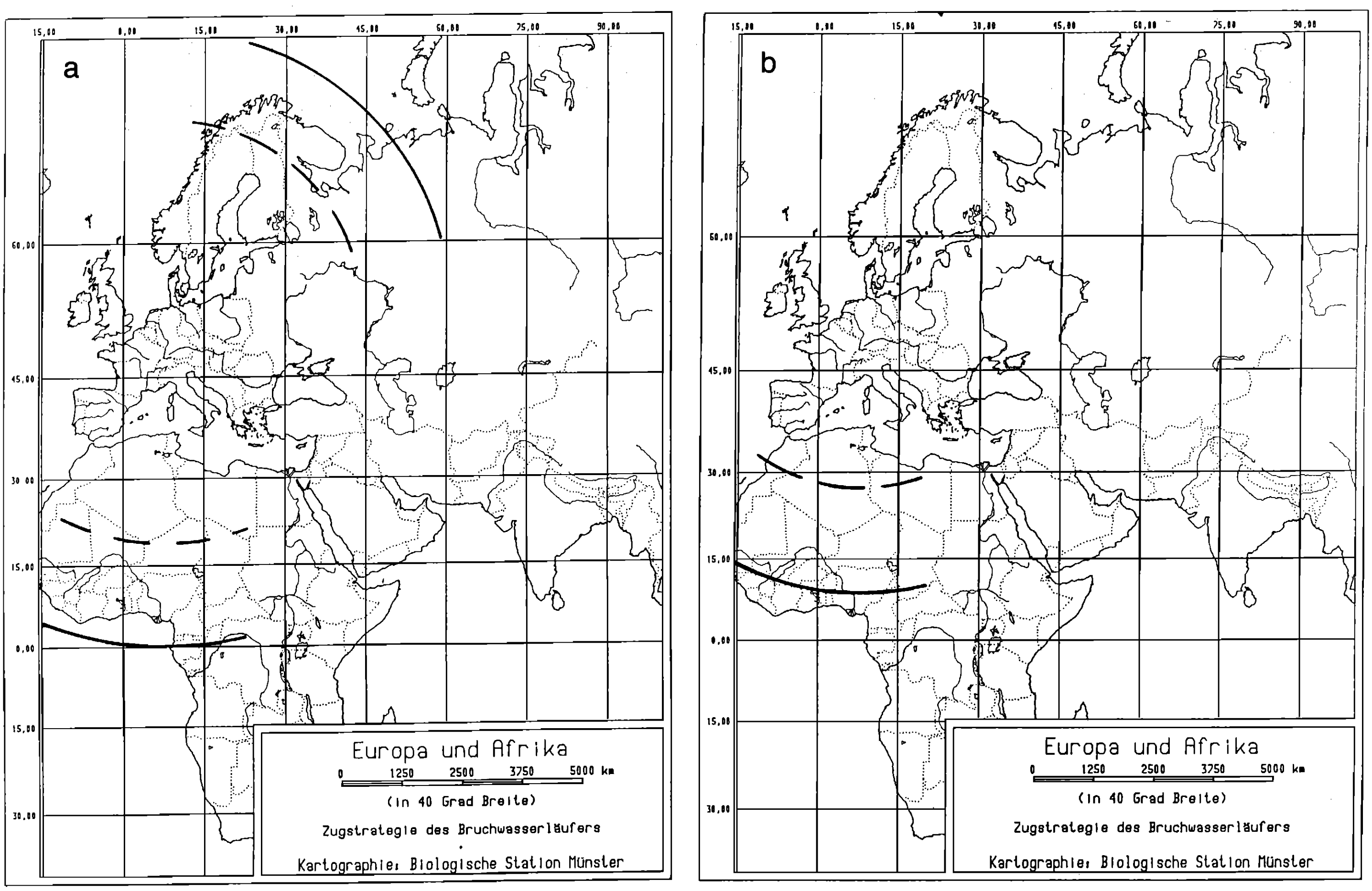

Figure 28. Theoretical flight ranges of a) adult and b) juvenile Wood Sandpipers caught in the sewage farms of Munster. Solid lines: estimate based on the heaviest 10% of birds; dashed lines: estimate based on all birds (OAG Munster in prep.).

compared to the numbers which should have been expected from the estimated numbers of breeding birds (Piersma 1986). This discrepancy is very large even if it is considered that many birds rest within the report area but not at counting sites, and thus so are not counted.

Migration dates which are earlier on the coast than inland are another phenomenon which is obvious for several of the species, especially for those which are numerous on the coast as well as inland. The results of the counts of these waders taken together with the limited information about the age structure of resting flocks (Glutz von Blotzheim *et al.* 1975, 1977) indicate that adults tend to rest (and to moult) in coastal sites. Inland, where resting conditions are often much less predictable, mainly juveniles are found. Possibly juveniles and adults of some species follow completely different migration strategies. Adults aim at certain resting sites well known to them while juveniles look for suitable habitat in a more or less opportunistic way. If it is true that inland sites maintain large parts of the juvenile populations of some species, these sites - even if the totals of birds resting in them are lower than those for coastal sites - play an important role in the life cycles of the species under consideration. They may be refuges for an important part of the population, the juveniles which in other places may not be able to withstand the competitive force of their adult conspecifics. Goss-Custard and le V. dit Durell (1987) have showed such competition for the Oystercatcher *Haematopus ostralegus*. Loss of inland sites would be expected to increase juvenile mortality. The evidence for Oystercatchers suggests that any such increase in mortality could seriously affect the age-structure of the species and lead to declining population size.

The counts enable us to see some phenomena which can be detected only by comparisons of data collected over wide geographical regions. To what extent loss of inland habitats are affecting wader populations can not be determined from counts alone, although results of the counts do form the basis of hypotheses.

FUTURE PROSPECTS OF THE PROJECT

Collection of count data for the studies of migration phenology and habitat selection is nearly complete. However, some of the results presented here remain very speculative, since complex migration patterns, especially where these involve several populations, cannot be unravelled by counts alone. Here data from ringing and/or colour-marking studies are needed to confirm and clarify the findings. For studying population trends the counts will need to be carried on at least some of the sites. For this part of the project, our aim is for 10 years of counts.

This inland wader project has used counts at sample locations throughout a large part of central and western Europe. A valuable expansion of the current project, one of great use to nature conservation throughout Europe would be to discover the total numbers of waders that rest in European inland wetlands, and how many wetlands are available for the waders. An inventory of the inland resting sites seems to be needed urgently.

SUMMARY

This paper summarizes the aims and the methods of Inland Wader Counts, a Wader Study Group project organised by OAG Münster, involving about 300 volunteers counting waders regularly in more than 200 resting sites, most of them inland, in 12 European countries. Possible ways of contributing to the project are outlined. The preliminary results of the project presented here show the timing of autumn migration of 20 wader species in inland west and central Europe. Median dates were used to measure the migration periods and were calculated for grid areas in different regions. For Ringed Plover and Dunlin there was a significant progression of median dates from north to south. For Knot and Curlew Sandpiper there was a significant east-west trend in dates. Data for Common Snipe and Common Sandpiper suggest a north-south trend, but the trend was not statistically significant. No other species show geographical trends in timing of migration. Some of the patterns are still hard to interpret due to lack of material or due to various complicating factors like the presence of breeding and overwintering birds. The fact that most of the species under consideration have their migration peaks at about the same time all over inland western and central Europe suggests that individuals rest in that area only once per migration. Species resting both in coastal and inland habitats generally show earlier migration peaks on the coast. This is probably due to a higher proportion of juveniles in inland sites.

ACKNOWLEDGEMENTS

We would like to thank the following persons for counting waders or organizing the counts in their countries:

BELGIUM: R.Deman, P.Meire.

FEDERAL REPUBLIC OF GERMANY: S.Belting, H.Blindow (WAU), K.-H.Blockhaus, DBV Wallnau, C.Dillenburger, W.Dornberger, G.Fechner, T.Gall, M.Gellermann, V.Giehr, K.Grebe, R.Guldi, K.u.U.Handke, R.Hennes, E.Henss, H.Jacoby, T.Jaspert, M.Kimmer, G.Knotzsch, H.Knuwer, E.v.Krosing, N.Krott, K.-H.Kuhnapfel, A.Kunz, S.u.U.Mahler, J.-H.Muhlstegen, G.Niehaus, H.Oosterwyk, G.Pannach, K.Rettig, N.Roth, M.Schreiber, S.Schuster, Schutzstation Wattenmeer, H.Schwarthoff, G.Sennert, J.Streichert, L.Tomanek, K.Trellinger, U.Wagner, M.Werner.

FRANCE: C.Andres, A.Bernard, F.Blanchard, M.Chantereau, D.Chavigny, J.Collette, X.Connecy, M.Dehlinger, C.Dronneau, P.Etienne, J.-M.Faton, G.Flacher, A.Fleury, A.Forlot, M.Fouquet, GAEO, GODY, Y.Grall, D.Ingremeau, H.Kowalski, S.Laplaca, F.Montel, P.Pigeon, C.Riols, J.M.Rollet, A.Sauvage, J.-P.Siblet, F.Sueur, F.Thommes, Y.Thonnerieux, P.Triplet, P.Vagner and viele andere.

UNITED KINGDOM: N.Addey, T.P.Appleton, G.A.Arnold, S.Barstow, A.W.Brown, G.B.Brown, L.M.Brown, E.S.Clare, J.Clark, K.G.Clifford, A.R.Dean, J.Eyre-Dickinson, F.P.Littlemore, G.L.Sandeman, R.W.J.Smith, J.Sorenson, L.L.J.Vick, G.Welsh.

THE NETHERLANDS: T.Bakker, J.F.Bekhuis, J.Bredenbeek, P.Brouwer, H.Buesink, M.Buruma, A.J.v.Dijk, W.Ganzevles, G.J.Gerritsen, G.Groot Koerkamp, K.Koopmans, C.v.Leeuwen, P.J.Rozemeijer, W.Ruitenbeek, S.Santing, R.Schravendeel, A.Timmerman, F.L.L.Tombeur, J.Tromp, H.v.Wijk, E.Wijmega, H.Wijmeijer, M.Winia.

NORWAY: E.Chapman, H.Loudbrekke, J.R.Wilson.

AUSTRIA: V.Blum, A.Grull, P.Prokop.

POLAND: A.Dombrowski, W.Grabinski, J.Gromadzka, H.Kot, T.Stawarczyk.

PORTUGAL: R.Rufino.

SWITZERLAND: P.Broz, H.Leuzinger, W.Muller, B.Schelpert.

SPAIN: J.L.Alberto.

CZECHOSLOVAKIA: V.Lnenickova.

HUNGARY: P.Bod, G.Kovacs, L.Mag, M.Marian, E.Schmidt.

This list is certainly incomplete because many names are representing larger working groups. We thank also all the other contributors to the project who could not be mentioned here.

REFERENCES

Bauer,W., Kliebe,K., Sartor,J. and Wehner,R. 1968. Der Limikolenzug in Hessen, II. Teil. *Luscinia* 40: 67-94.
Bezzel,E. and Wust,W. 1965. Vergleichende Planbeobachtungen zum Durchzug der Watvogel (Limicolae) im Ismaninger Teichgebiet bei Munchen. *Anz. Orn. Ges. Bayern* 7: 429-474.
Cramp,S. and Simmons,K.E.L. (eds.) 1983. *The Birds of the Western Palearctic* Vol. 3. Oxford University Press, Oxford.
Glutz von Blotzheim,U.N., Bauer,K.M. and Bezzel,E. 1975, 1977. *Handbuch der Vogel Mitteleuropas*. Vols. 6 and 7. Akademische Verlagsgesellschaft, Wiesebaden.
Goss-Custard,J.D. and dit Durell,S.E.A. le V. 1987. Age-related effects in oystercatchers, *Haematopus ostralegus*, feeding on mussels, *Mytilus edulis*. 1-3. *J. Anim. Ecol.* 56: 521-536, 537-548, 549-558.
Harengerd,M., Prunte,W. and Speckmann,M. 1973. Zugphanologie und Status der Limikolen in den Rieselfeldern der Stadt Munster. *Vogelwelt* 94: 81-118, 121-146.
Imboden,C. 1974. Zug, Fremdansiedlung und Brutperiode des Kiebitz *Vanellus vanellus* in Europa. *Orn. Beob.* 71: 5-134.
Klein,H. 1972. Ergebnisse der Limikolenzahlung in Nordrhein-Westfalen in den Jahren von 1967-1972. *Charadrius* 8: 114-150.
Mason,C.F. 1984. The passage of waders at an inland reservoir in Leicestershire. *Ringing & Migration* 5: 133-140.
Moser,M. 1985. Curlew Sandpiper influx. *BTO News* 141:1.
OAG Münster. 1976. Zur Biometrie des Alpenstrandlaufers (*Calidris alpina*) in den Rieselfeldern Munster. *Vogelwarte* 28: 278-293.
OAG Münster. 1981. Inland Wader Counts - First Progress Report. *Wader Study Group Bull.* 32: 20-23.
OAG Münster. 1982. Inland Wader Counts - Second Progress Report. *Wader Study Group Bull.* 35: 11-13.
OAG Münster. 1983. Zur Gewischtsentwicklung und Biometrie des Sichelstrandlaufers (*Calidris ferruginea*) in den Rieselfeldern Munster. *Vogelwarte* 32: 23-32.
OAG Münster. (in prep.) Zug und Biometrie des Bruchwässerlaufers in den Rieselfeldern Munster.
Piersma,T. 1986. Breeding waders in Europe: a review of population size estimates and a bibliography of information sources. *Wader Study Group Bull.* 48 *Suppl.*: 1-116.
Piersma,T., Beintema,A.J., Davidson,N.C., OAG Munster and Pienkowski,M.W. 1987. Wader migration systems in the East Atlantic. *Wader Study Group Bull.* 49, *Suppl.*: 35-56.
Sachs,L. 1978. *Angewandte Statistik*. 4. Aufl. Springer, Berlin.
Stanley,P.I. and Minton,C.D.T. 1972. The unprecedented westward migration of Curlew Sandpipers in autumn 1969. *British Birds* 65: 365-380.

OAG Munster, Biologische Station Rieselfelder Munster, Coermuhle 181, 4400 Munster, Federal Republic of Germany