Aspects of spring migration of some wader species in inland Europe

OAG Münster: progress report of the WSG inland wader count project

OAG Münster 1994. Aspects of spring migration of some wader species in inland Europe. *Wader Study Group Bull.* 73: 62-71.

This report provide preliminary analyses of the spring migration of 14 wader species through western Europe, based on median migration dates for the 10 year period 1979-1988. Data were collated as part of a WSG project involving counts by many volunteers in 11 countries. Birds of nine of the 14 species seem to use only a single staging site in migrating through western Europe; individual Lapwings, Dunlins, Ruffs, Common Snipe and Common Sandpipers seem to use more than one European staging site during spring migration.

OAG Münster, Biologische Station, Coermühle 181, 48157 Münster, Germany

INTRODUCTION

During the last 20 years much research has been carried out on waders in Europe, much of it at coastal sites along the East Atlantic Flyway. The results of these studies, in part organised by the Wader Study Group on an international level and in co-operation with many ornithologists and ringers from several countries, have led to a better knowledge of migration systems, important stop-over-sites and numbers of birds using this flyway (for review see Smit & Piersma 1989).

In contrast to species migrating mainly along the coast, research on typical inland waders was restricted to single sites. Here wader migration was, however, investigated intensively at some places (*e.g.* Bezzel & Wüst 1965; Harengerd *et al.* 1973; Mason 1984). But results from a single site may not necessarily be representative for a wider geographical region and, of course, cannot give any idea of numbers of birds within the area as a whole.

Along with other international wader studies the "Inland Wader Count" project was started in 1979 to gather information from as many sites as possible over a large area covering Central and Western Europe. Up to now about 300 volunteers from 14 European countries have contributed to the project with more or less regular surveys at about 240 resting sites during the period from March to October.

Aims and progress of the project have been described in previous papers (*e.g.* OAG Münster 1981). First results concerning the autumn migration of inland waders have already been published (OAG Münster 1987). In this progress report we try to fill a gap in the knowledge of waders on the East Atlantic Flyway mentioned by Piersma *et al.* (1987), in particular the spring migration patterns of inland waders.

METHODS

This study is based on counting data gathered in the years from 1979 to 1989 from the sites listed in Table 1. Sites were grouped into grid squares of four degrees of longitude and two degrees of latitude (Figure 1). Sites have been included in the analysis where only data was gathered at least once during each five-day-period throughout the spring migration period.

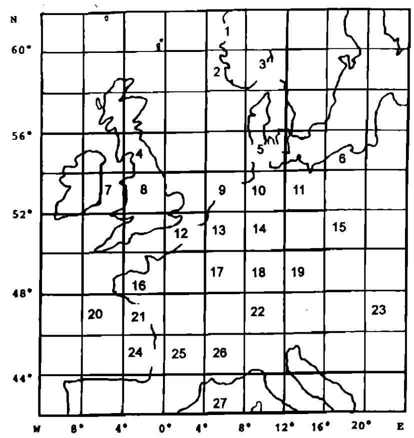

Figure 1 Numbering of grid squares with counting sites

The spring migration period was defined as from 1 March to 7 June for all species, with the exception of Lapwing and Black-tailed Godwit for which the period was 1 February to 30 April. At the beginning and the end of this period there still may be birds present at some sites because they winter or breed there. The fact that spring migration could not always be separated exactly from other circannual processes must be taken into account by interpreting the calculated migration dates (see species discussions).

Some species do not migrate at all, or are very scarce in inland habitats during spring migration. For these species there is insufficient data available for detailed analysis (*e.g.* Curlew Sandpiper, Little Stint). Many of the Little

Ringed Plovers counted were resident breeding birds, so this species has also been excluded from the analysis.

Table 1. Grid squares and sites used in the analysis of spring wader migration: grid square numbers refer to those shown in Figure 1 and are arranged from NW to SE.

Grid square	Sites with data
1	Rekvesoeyane, Melsvatnet Voss, Reppen Voss, Gjernesmoen
2	Grudavannet
3	Oeyeren-Tuentangen, Oeyeren-Arnestangen/Rossholmen
4	West Water Reservoir, Gladhouse Reservoir
5	Hörnum/Sylt, Amrum, Westerhever, Wallnau, Frederikshab & Omr.
6	Hel Peninsula
7	Llyn Alaw Reservoir Anglesey
8	Blithfield Reservoir, Alvecote Pools Nature Res., Fairburn Ings, Draycote Water
9	Spülfelder Riepe, Rieselfelder Nordhorn and Münster, Engbertsdijkvenen, Nieuw-Buinen, Dwingelose & Kraloer Heide
10	Dümmer, Rieselfelder Braunschweig, Salzgitter-Heerte and Hannover-Garbsen, Spülfelder am Kattegatt, Wedeler Marsch
11	Rieselfelder Wassmannsdorf
12	Marquenterre, Marais de Rue, Abberton Reservoir
13	Rieselfelder Lünen, Escher Bürge, Appelhülsen and Eignerbach, Rheinaue Walsum, Bergsenkungsgebiet Soisdorf, Erlekomse Waard & Kaliwaal-Ooypolder, Eysden, Maneswaard, Schoutenwaard
14	Rieselfelder Hattrop and Soest, Rhäden vom Obersuhl
15	Roskos Reservoir
16	La Dathee
17	Kiesweiher Nennig-Besch, Bostalstausee, Donchery Les Ayvelles, Attigny, Lac du der Chantecoq, Vrizy-Vandy-Terron-Sur-Aisne, Rohrschollen, Graffenmatt, Gambsheim, Lac de Cattenom
18	Gross-Gerau, Lampertheimer Altrhein, Klärteich Offstein, Roxheimer Altrhein, Wagbachniederung, Ismaning, Altmühlsee
19	Echinger Stausee, Rötelseeweiher
20	Confluence Maine-Sarthe-Loire, Reserve Biologique de Falguerec, Etangs Nord Deux-Sevres, Marais de Gree
21	Brenne, Loire-Jargeau, Lac du Cebron
22	Bodensee-Radolfzell, Wollmatinger Ried, Rhein-Delta-Bodensee, Stausee Klingnau, Aegelsee, Neeracherriet, Flachsee Unterlunkhofen, Thur-Talung
23	Szeged Feherto, Fueloephaza, Lake Csaj, Hortobagy-Nationalpark, Fish pond Akademia, Nagyivan Puszta
24	Parc Ornithologique du Teich, Lac de Laprade
25	Bourdon - Clermont Ferrand, Lascols
26	Pont D'Isere, Dombes
27	Reserve Nationale de Camargue

Migration dates shown in the figures refer to the third day (the mid day) of the five-day-period in which the median falls. The median indicates the date at which 50 % of the birds have been counted during the migration period. Medians based on few observations and/or very small numbers were excluded from the analysis. Precision of the median usually rises with increasing numbers of surveys and also with increasing average numbers of birds. This means that at sites which hold only few individuals medians can vary more or less accidentally. Statistical methods follow Sachs (1978), and use Spearman Rank correlations (r_S). For a detailed description of the calculation method see OAG Münster (1987).

The migration step from Central/Western Europe to sites in Southern Scandinavia (Norway) is a considerable distance over which the North Sea/Baltic Sea may act as ecological barriers. A trend in latitudinal migration dates between these regions would not be surprising. Therefore in the following analysis correlations between median dates and degrees of latitude are investigated only with data from sites located in Western/Central Europe.

This report was compiled by Johannes Melter.

RESULTS

Ringed Plover Charadrius hiaticula *(Figure 2)*

Ringed Plovers mostly migrate along the coast and but can also be found at inland sites in small numbers. Spring migration is less marked than autumn migration in inland Europe.

The distribution of medians reveals a rather irregular pattern. Whereas medians from coastal western European sites are similar, the mean migration dates in other region show greater variations. But it must be considered that in some of these sites on spring migration Ringed Plovers occur just in small numbers so that means that the median is based on few data. There is no trend in the medians from south to north.

On the other hand, differences may reflect the migration of different populations or subspecies. At some inland sites more than one peak of spring migration occurs (*e.g.* Bezzel & Wüst 1965). A staggered migration pattern was also found for some regions in this analysis, as it is shown in Figure 3 for sites in Germany/Netherlands and southern

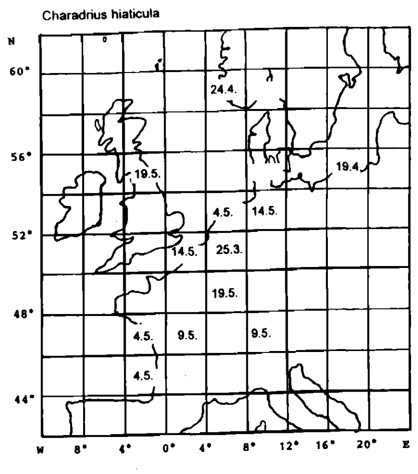

Figure 2. Median dates for spring migration of Ringed Plover.

France. The first peak normally occurs in mid March and the second in May. The origin of these birds is not yet clear. Ringing studies will presumably yield better results for this species.

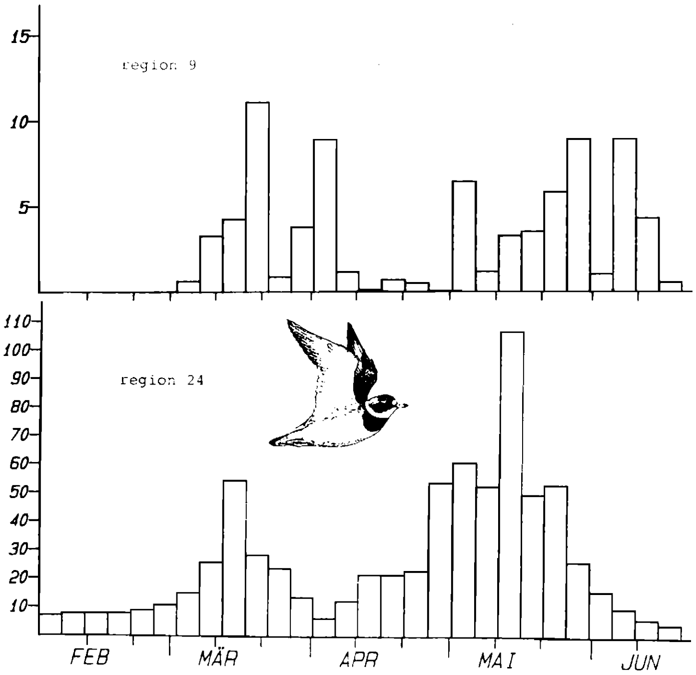

Figure 3. Spring migration pattern of Ringed Plovers in two regions (see Table 1) described by mean numbers of birds per five-day-period.

Lapwing Vanellus vanellus *(Figure 4)*

Lapwings breed in almost all regions within the report area and also overwinter in its western parts (France, England). Moreover, in the western regions partial spring migration may start before 1 February whereas at northern sites Lapwings can be observed on "Zwischenzug" (a kind of early return migration) from May onwards (see Imboden 1974). Migration patterns for some regions are plotted in Figure 5.

Migration cannot be separated completely from other circannual processes which obviously may have an effect on the median dates of migration. Furthermore the migration system of Lapwings seem generally too complicated, including a "Zwischenzug" or moult migration, for an analysis using the methods of this study. There are slight but significant trends, however, in a delay of the median dates from southern to northern Central-Europe ($r_S = 0.478$, $p < 0.05$) and also from west to east ($r_S = 0.446$, $p < 0.05$).

Dunlin Calidris alpina *(Figure 6)*

In winter Dunlin can be found at almost all counting sites along the coast of western Europe, and numbers are (e.g. Trolliet 1992) particularly high in the Parc Ornithologique du Teich. This fact may well have influenced the medians. So it is not surprising that there is a slight delay in the time of migration from south to north (Figure 7; $r_S = 0.654$, $p < 0.05$). Altogether there is a shift in timing of migration of about two months. The median for the Hungarian sites is rather unusual compared with all other regions; this may be due to different places of origin and winter quarters of these birds, perhaps using the Mediterranean Flyway.

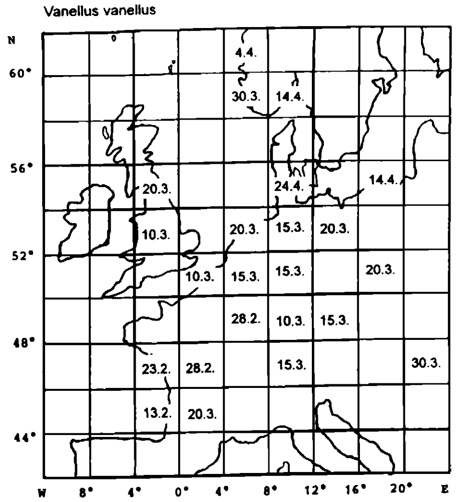

Figure 4. Median dates for spring migration of Lapwing.

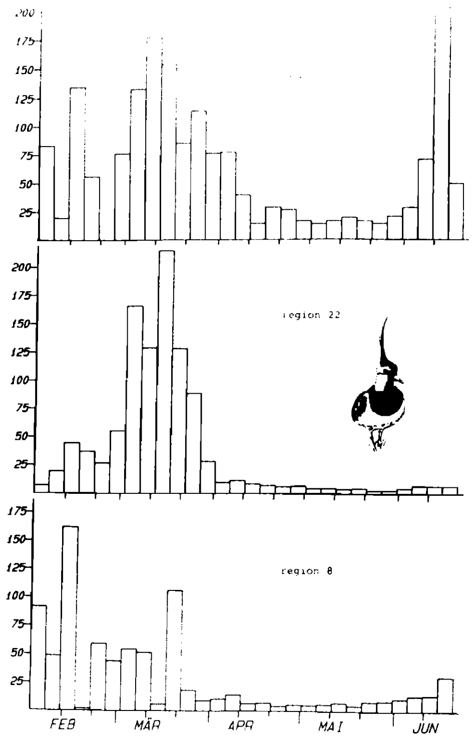

Figure 5. Spring migration pattern of Lapwing in three regions (see Table 1 and Figure 3).

Ruff Philomachus pugnax *(Figure 8)*

Since the breeding population has declined considerably during the last few decades the Ruff is now an almost exclusively migrant species within the report area. From year to year Ruffs sometimes winter in small numbers in the southern area but this does not affect the medians.

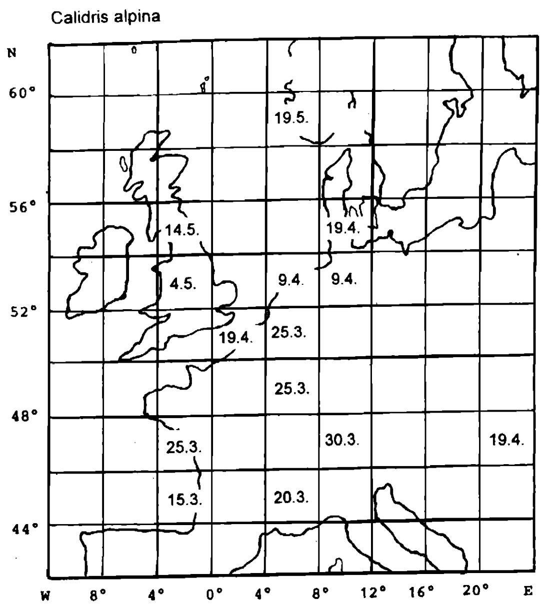

Figure 6. Median dates for spring migration of Dunlin.

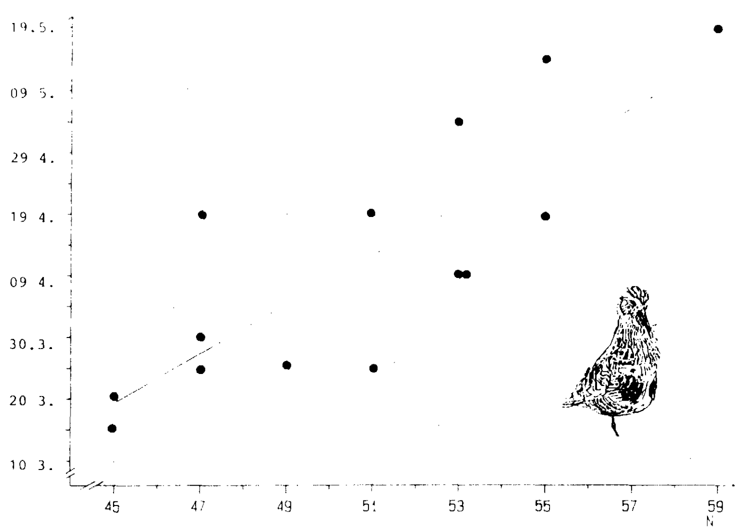

Figure 7. Correlation between median date of Dunlin spring migration and latitude.

The Ruff is a typical inland wader species which prefers freshwater ecosystems. For Ruffs wintering in the Senegal-Delta wetlands in Western/Central Europe provide the first opportunity for the birds to build up their energy reserves after a long non-stop-flight across the Sahara and the Mediterranean Sea (OAG Münster 1989a).

Hitherto it has been supposed that these birds continue migration from here maintaining the strategy of long distance flights, so-called jumps (Piersma 1987), and therefore just should stop once within the report area.

The distribution of the median dates throws doubt on this hypothesis because there is a distinct and statistically significant trend of a delay of migration dates from south to north (Figure 9; $r_S = 0.733$, $p < 0.01$). For better illustration of these findings, the migration patterns from some regions are shown in Figure 10.

The reasons for this trend are not yet clear. It is conceivable that at least a part of the population make more than one stop when crossing inland Europe. On the other hand, absolute numbers of Ruffs resting in the Netherlands and northern parts of West Germany (Hötker 1988; OAG Münster 1990) outnumber those resting in southern France to such an extent that it seems unlikely that all the birds staging in the Netherlands and northern Germany had already stopped beforehand in France.

More research is clearly needed on the migratory strategy of Ruffs.

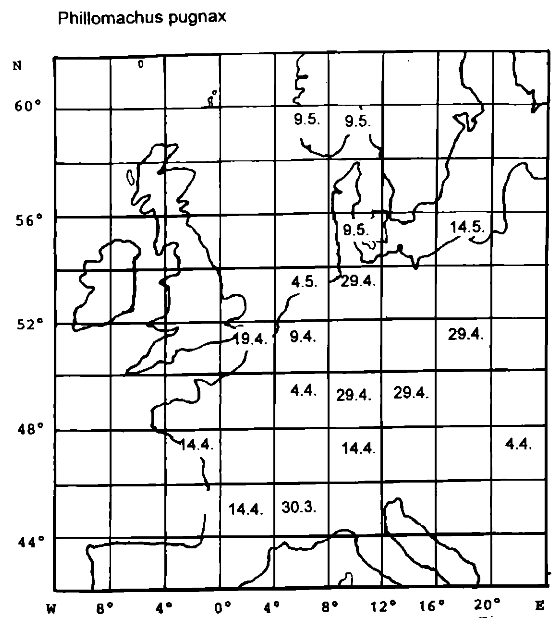

Figure 8. Median dates for spring migration of Ruff.

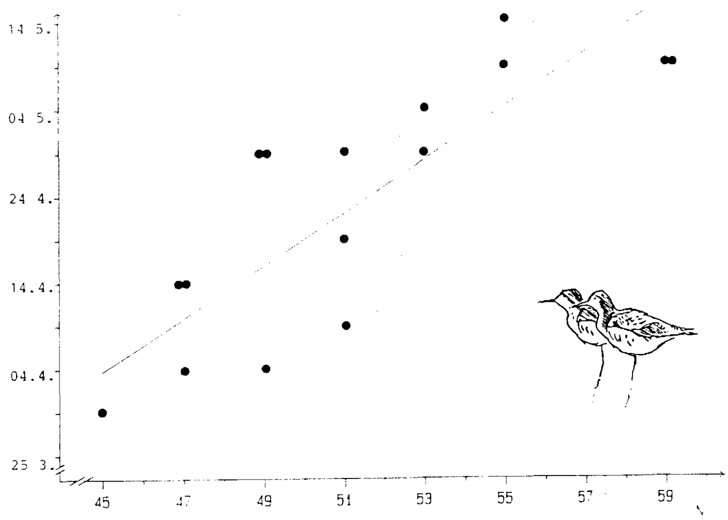

Figure 9. The correlation between median date of spring migration of Ruff and latitude.

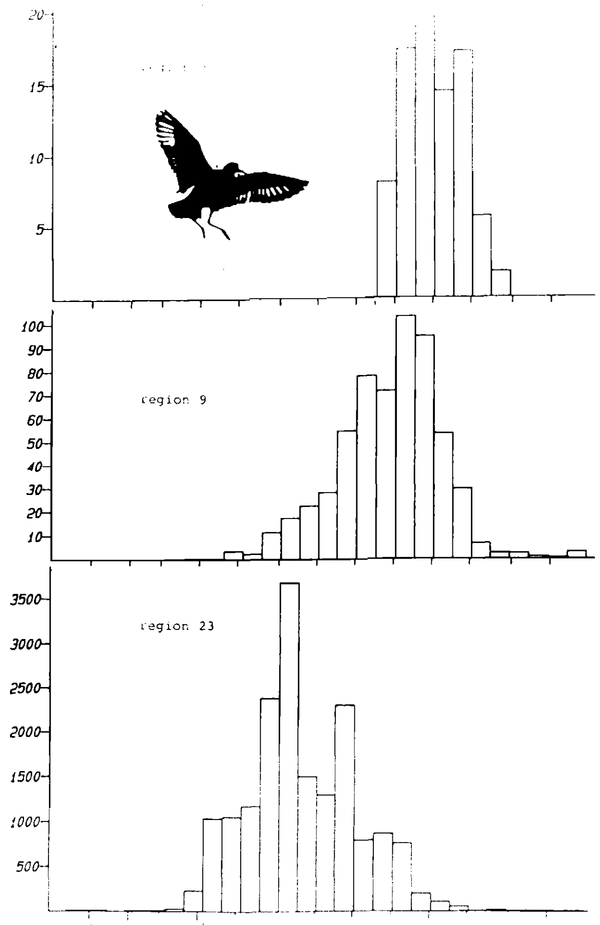

Figure 10. Spring migration pattern of Ruff in three regions (see Table 1 and Figure 3).

Common Snipe Gallinago gallinago *(Figure 11)*

The Snipe is both a breeding and wintering species within the report area. Whereas the breeding population at most of the sites is confined to few pairs the wintering population may have a greater influence on the medians. According to changes in migration patterns (Beintema & Müskens 1982), Great Britain and western Europe are important winter quarters for this species.

There is a slight but statistically significant shift in the timing of migration from south to north ($r_S = 0.522$, $p < 0.05$). Leading from the settlement of wintering birds in western Europe, it is not surprising that there is such a trend from west to east as well ($r_S = 0.651$, $p < 0.01$).

This result is similar to the migration pattern of the Curlew which is the other species wintering in large numbers in western Europe.

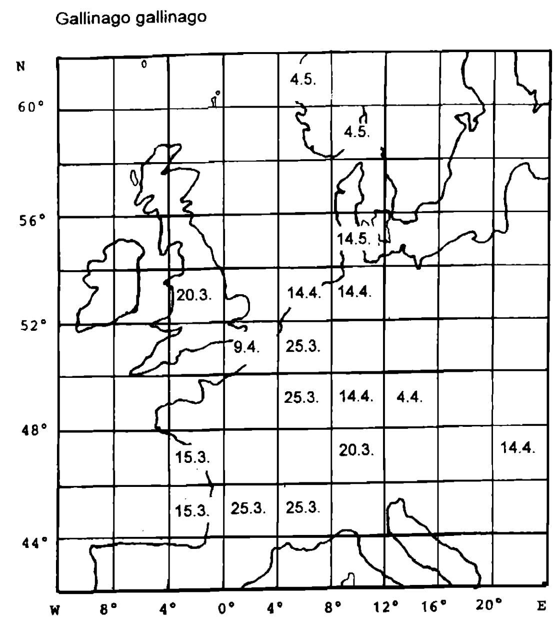

Figure 11. Median dates for spring migration of Snipe.

Black-tailed Godwit Limosa limosa *(Figure 12)*

The distribution of medians of Black-tailed Godwits shows a peculiar pattern with variations of more than 20 days even between neighbouring regions. In southern France migration already has laready begun by the end of January and peaks in March (Blanchon *et al.* 1984). This early data may be influenced by birds wintering in France (*e.g.* Troilliet 1992). More reasons for the great variation in medians may be found in the breeding distribution of the species. Some regions include sites solely used as resting places, whilst others also have a breeding population or are adjacent to breeding habitats, so the data from different regions are not directly comparable.

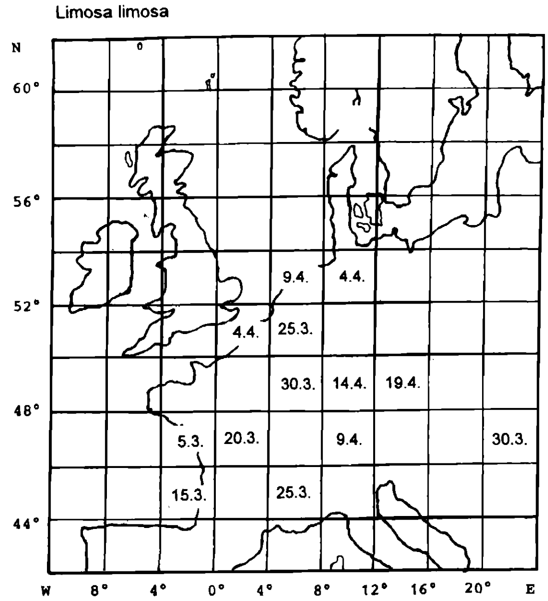

Figure 12. Median dates for spring migration of Black-tailed Godwit.

Whimbrel Numenius phaeopus *(Figure 13)*

The Whimbrel is a very irregular migrant in inland habitats on spring migration. So calculations of medians were largely confined to coastal sites. In all regions Whimbrel migrate at about the same time: the variation in median dates is only five days. The dates correspond very well with those for another site in western France (Blanchon *et al.* 1984).

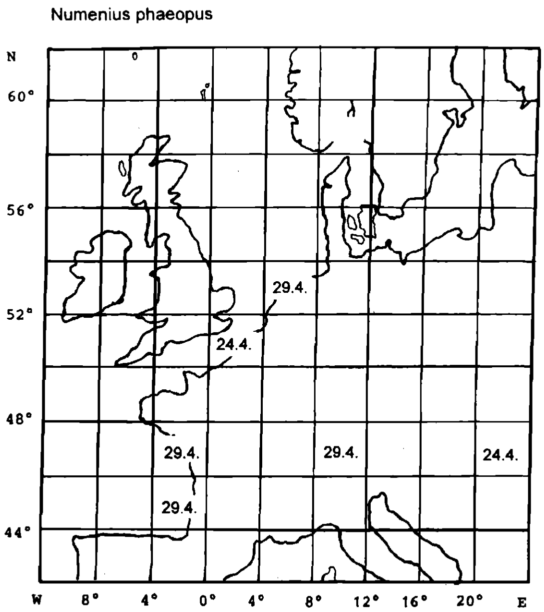

Figure 13. Median dates for spring migration of Whimbrel

Curlew Numenius arquata *(Figure 14)*

Interpretation of median dates for Curlew is made difficult by the fact that this species not only winters in the western region of the study area (France, Great Britain) but also breeds in the surroundings of many counting sites. Furthermore spring migration may start before 1 March in the western regions.

It is noteworthy that, with the exception of the dates for southern Norway, medians do not vary more than one month between all regions. There is no trend in timing of migration from south to north except for a slight and statistically significant shift in the medians from west to east ($r_S = 0.489$, $p < 0.05$). This can probably be explained by the winter distribution.

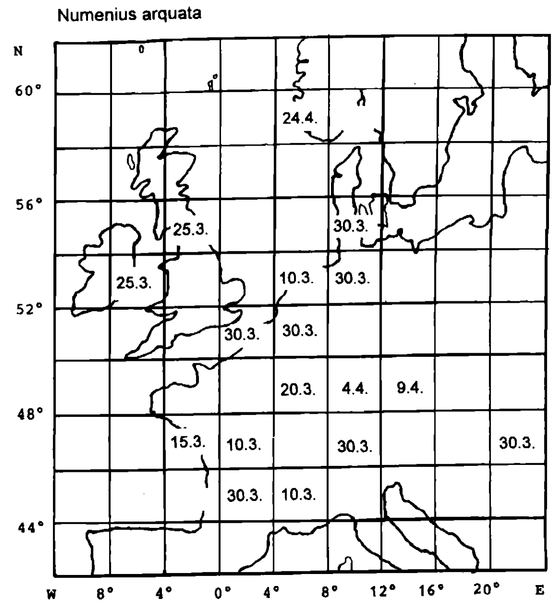

Figure 14. Median dates for spring migration of Curlew.

Spotted Redshank Tringa erythropus *(Figure 15)*

Spotted Redshanks regularly overwinter in small numbers at southern European sites along the coast. The small numbers of counted birds does not seem, however, to have any great influence on the median dates of spring migration. Indeed, peak migration occurs everywhere at about the same time, from mid April to early May. As there are differences between regions of up to a maximum of fifteen days no shift in timing of migration could be found.

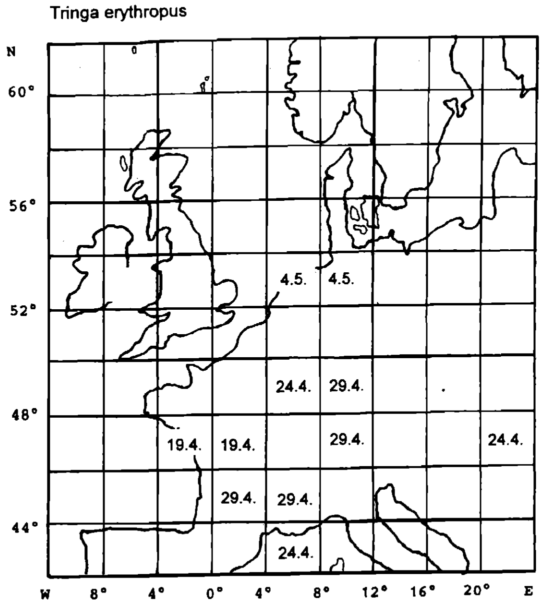

Figure 15. Median dates for spring migration of Spotted Redshank.

Redshank Tringa totanus *(Figure 16)*

Redshanks overwinter in relatively high numbers at many coastal sites. Both winter and spring migrant populations can consist of different subspecies (*Tringa t. totanus* and *T. t. robusta*). *T. t. robusta* breeds in Iceland. The nominate subspecies breeds throughout Continental/ Northern Europe and the former Soviet Union.

At some inland sites in spring two peaks of migration are regularly observed. This has led to the hypothesis of a time-shifted migration of different subspecies or populations (*e.g.* Harengerd *et al.* 1973). Although Redshanks in May seem to differ in plumage colour and size from early migrants it is not, however, always possible to distinguish subspecies clearly in the field.

Moreover around many sites, espcially in coastal habitats, Redshank may also occur as breeding birds. As a result of all these problems further interpretation based solely on counts is almost impossible. Here ringing work including biometrical studies in conjunction with detailed surveys is needed to obtain further information.

It is therefore not surprising that there is no trend in timing of migration from south to north. In general migration seems to start a little earlier in south-west than in central Europe, but the earliest date has been found in Hungary.

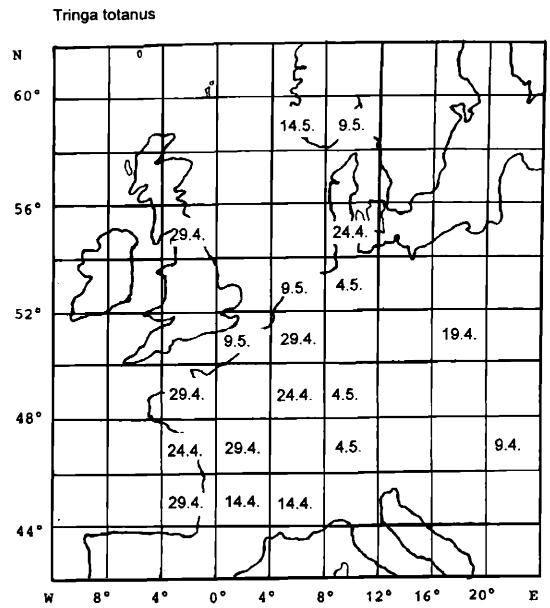

Figure 16. Median dates for spring migration of Redshank.

Greenshank Tringa nebularia *(Figure 17)*

Greenshanks do not breed in western or central Europe and overwinters irregularly, if at all, in very small numbers in the study area (*e.g.* Troilliet 1992).

The distribution of medians forms a very uniform picture. Greenshanks seem to migrate through all regions at about the same time. Differences in the timing of migration are a maximum of 20 days, with the earliest date has been found in Hungary. In central Europe medians only vary by about five days.

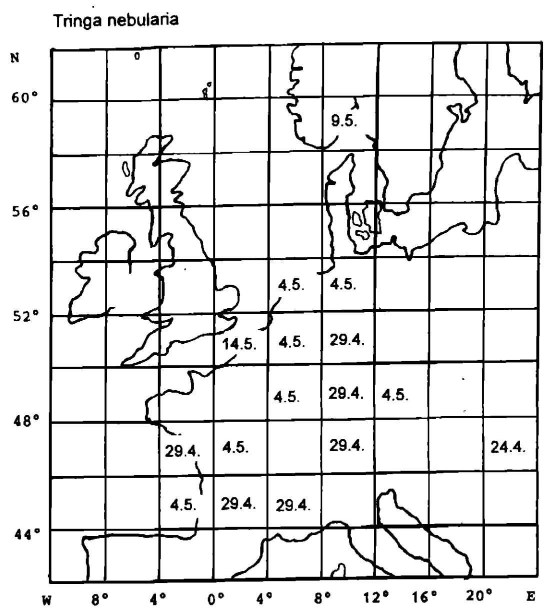

Figure 17. Median dates for spring migration of Greenshank.

Green Sandpiper Tringa ochropus *(Figure 18)*

The report area is situated within the wintering grounds of Green Sandpipers, which overwinter in small numbers at some of the counting sites (*e.g.* OAG Münster 1989b; Heg 1988) but this had little effect on the medians. As for autumn migration there are hardly any differences in the migration dates of Green Sandpipers within the report area throughout spring migration.

Medians in Central Europe vary by a maximum of about 10 days, and are about 15 days later in southern Norway.

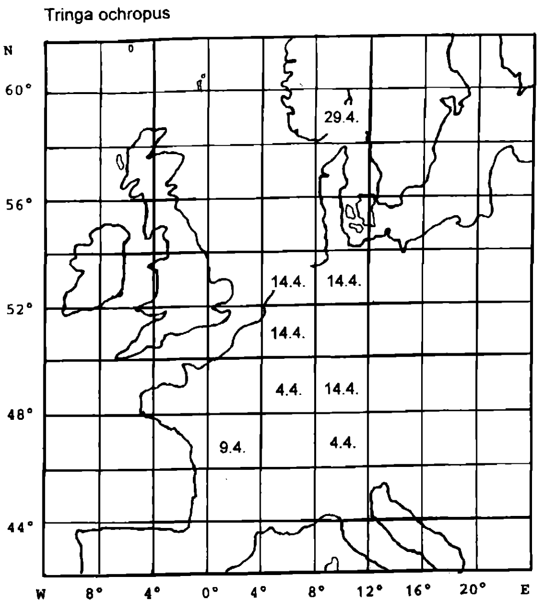

Figure 18. Median dates for spring migration of Green Sandpiper.

Wood Sandpiper Tringa glareola *(Figure 19)*

The Wood Sandpiper is exclusively a migrant species at all survey sites. Apart from minor differences this species migrates everywhere at about the same time, within a period of 20 days. There is little northwards shift in migration dates. It is striking that again the earliest date of median has been found in Hungary.

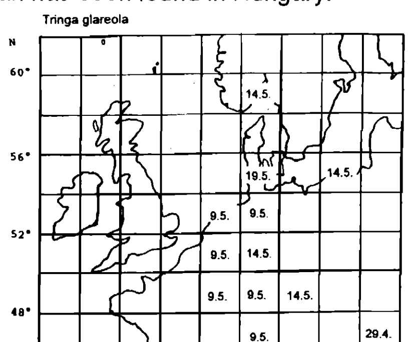

Figure 19. Median dates for spring migration of Wood Sandpiper.

Common Sandpiper Actitis hypoleucos *(Figure 20)*

Common Sandpipers migrate through central/western Europe at almost the same time (mid May) at all counting sites. Although there is a significant shift in migration (r_S = 0.626, $p < 0.01$) this is based on differences of just two weeks between sites in south and west France and northern Germany/Great Britain. The greatest difference in medians is of only 20 days, with the earliest date again being in Hungary.

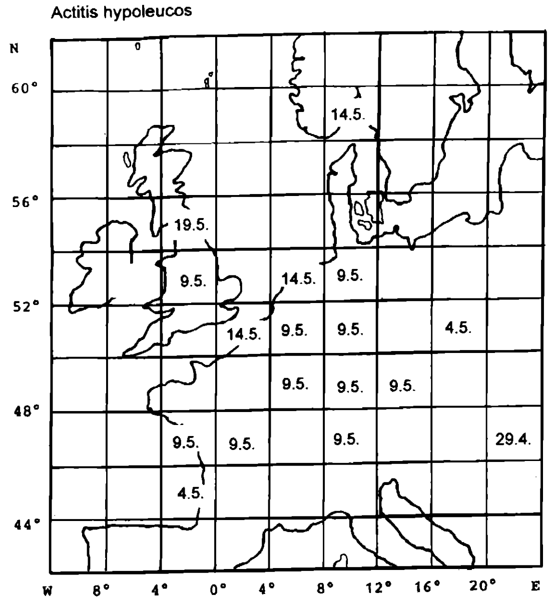

Figure 20. Median dates for spring migration of Common Sandpiper.

DISCUSSION

Since the results presented here are based solely on counting data this study cannot, of course, answer all questions concerning inland wader migration. On a descriptive level, however it yields a wide-ranging insight into the time-tables of spring wader migration through Europe.

There are species-specific patterns in timing and duration of migration. Differences in migration timing are probably related to the locations of winter quarters and breeding regions. For example Lapwings show early migration peaks, from the beginning of March, but other species like Wood Sandpiper have their peak migration throughout Europe in May. In a comparison of species it must be remembered, however, that results are based on information from different data sets with varying numbers of grid squares.

In this analysis we have used medians for the description of the peak migration within a region. Data from up to ten sites were combined in such a region (grid square). In

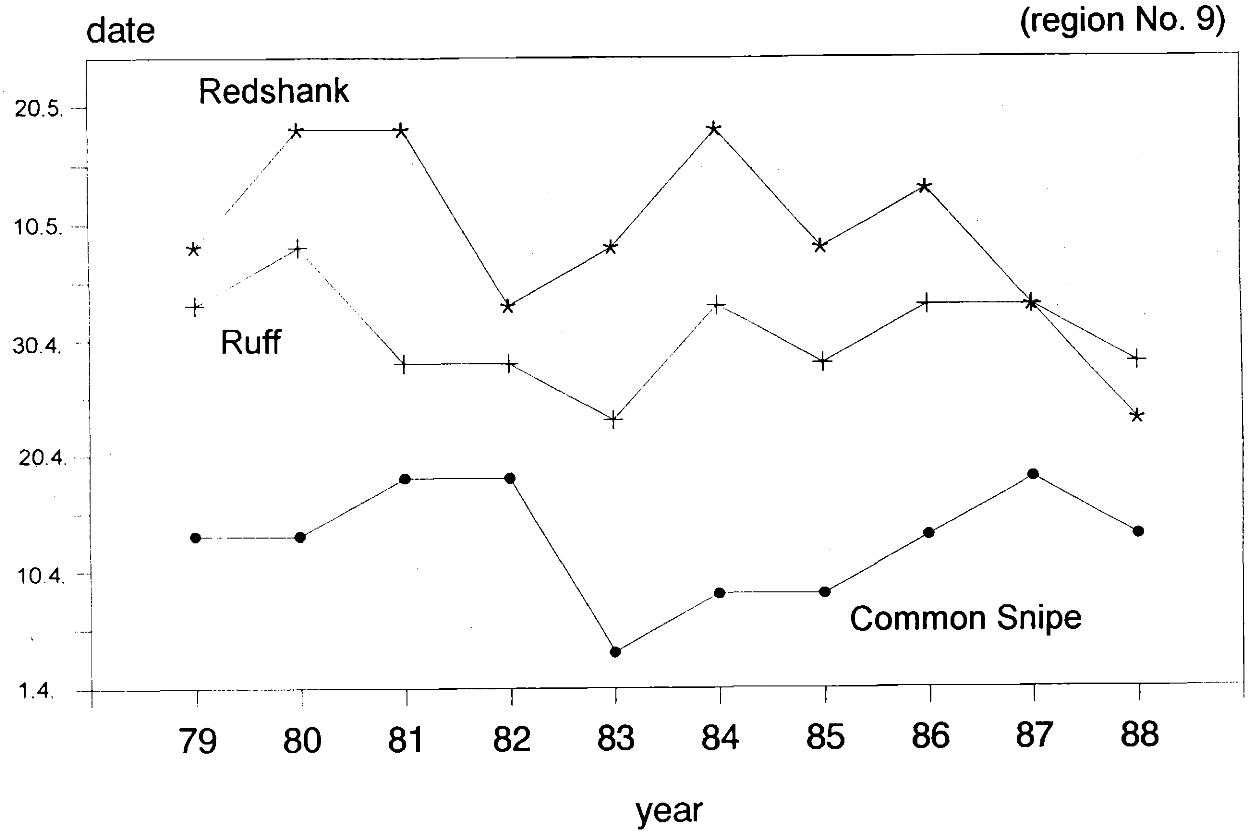

Figure 21. Variations in the median dates of some species in one region (northern Germany/Netherlands).

combining data from more sites and over a ten year period we could reduce the influence of unusual events at single sites and in exceptional years, *e.g.* changing ecological conditions or extreme weather conditions. On the other hand medians are not necessarily representative of the migration pattern at one site or a habitat.

Variations in medians can occur not only between sites in a region but also between years. For example Figure 21 shows the medians for three species over the 10 years of the project. This shows that there are considerable variations in the median migration date of each species in different years, and also that there is little interspecific synchrony in the variation. Weather conditions and the availability of suitable habitats may play an important role in the differences in migration pattern from year to year. Thus although the median is a very heterogenous measure, it seems a good parameter for assessing migration timing available from our studies.

In nine of the 14 species reported here, the distribution of median dates shows no south-north trend: such a shift in median dates has been found in only five species (Lapwing, Dunlin, Ruff, Common Snipe and Common Sandpiper). The duration of the migration period through western/central Europe is noticeably shorter for those species without a progression in timing of migration. Since these species have migration peaks at about the same time in all regions within the report area suggests that their migration strategy is to stop only once on their migration through western/central Europe. These birds therefore seem to cover the distance from wintering grounds to their breeding areas in a few long flights.

In several waders, espcially. *Tringa* species, migration peaks in Hungary occur earlier than in western sites at the same latitude. It is not yet clear where the 'borders' of the East Atlantic Flyway are, and it is possible that birds resting in Hungary originate from populations using the Mediterranean Flyway.

This paper can give some indications on migration strategies of waders, but there are limitations to the interpretation of count data. To answer questions concerning the numbers of stop-over-sites used on migration, and the length of stay at single sites, we need further detailed analysis of count data (which is in preparation) and ringing/colour-ringing studies of wader species at more inland sites.

ACKNOWLEDGEMENTS

The WSG inland wader count project depends on the data collected by many volunteers and also the help of some wader friends in organizing counts in their countries. Here we would like to thank all of them even if some work in a group and so are not mentioned personally here. This analysis is based mainly on data from:

Norway: E. Chapman, H. Lovbrekke, & J.R. Wilson.

United Kingdom: N. Addey, T.P. Appleton, G.A. Arnold, R.W. Arnold, S. Barstow, A.W. Brown, G.W. Brown, E.S. Clare, J. Clark, K.G. Clifford, A.R. Dean, J. Eyre-Dickinson, C. Lamsdell, F.P. Littlemore, G.L. Sandeman, R.W.J. Smith, J. Sorenson, L.L.Y. Vick, & G. Welch.

Denmark: M. Brinch-Pedersen.

Poland: Waterfowl Research Group Kuling, W. Meissner, M. Skakuj, & J. Gromadzka.

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. Wymenga, H. Wijmeijer, & M. Winia.

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, Ch. Haaß, K. & U. Handke, R. Hennes, E. Henß, H. Jacoby, T. Jaspert, M. Kimmer, G. Knötzsch, H. Knüwer, O. Kowalski, E.v. Krosigk, N. Krott, K.-H. Kühnapfel, A. Kunz, S. & U. Mahler, J.-H. Mülstegen, G. Niehaus, H. Oosterwyk, G. Pannach, H. Ranftl, H. Reinhardt, K. Rettig, N. Roth, R. Schimmelpfennig, B. Schonert, M. Schreiber, S. Schuster, Schutzstation Wattenmeer, H. Schwarthoff, G. Sennert, H. Siegel, J. Streichert, L. Tomanek, K. Trellinger, U. Wagner, & M. Werner.

Czech Republic & Slovakia: K. Dohnal, V. Hromadkova, V. Koza, V. Lnenickova & P. Zdanek.

France: P. Albert, A. Armouet, C. Andres, J. Bec, A. Bernard, P. Berthelot, F. Blanchard, M. Chantereau, D. Chavigny, J. Colette, X. Commecy, M. Dehlinger, C. Dronneau, P. Etienne, J.-M. Faton, G. Flacher, A. Fleury, L. Folk, A. Forlot, M. Fouquet, L. Gizard, G.O.L.A., Y. Grall, F. Hardy, D. Ingremeau, H. Kowalski, S. Laplaca, F. Montel, P. Pigeon, G. Prolhac, B. Recorbet, C. Riols, J.M. Rollet, A. Sauvage, J.-P. Siblet, F. Sueur, F. Thommes, Y. Thonnerieux, P. Triplet, & P. Vagner.

Switzerland: H. Leuzinger, W. Müller, B. Schelbert, & M. Weggler.

Austria: D. Bruderer, V. Blum, A. Grüll, B. Kohler, B. Prokop, G. Rauer, P. Willi, & E. Winter.

Hungary: P. Bod, G. Kovacs, S. Laszlo, L. Mag, M. Marian, L. Molnar, E. Schmidt, & E. Zoltan.

REFERENCES

Beintema, A.J. & M•skens, G.J.D.M. 1982. Changes in the migration pattern of the Common Snipe. *Proc. 2nd Eur. Woodcock & Snipe Workshop:* 146-160.

Bezzel, E. & W•st, W. 1965. Vergleichende Planbeobachtungen zum Durchzug der Watvögel (Limicolae) im Ismaninger Teichgebiet bei München. *Anz. Orn. Ges. Bayern* 7: 429-474.

Blanchon, J.-J., Dubois, P. & Metais, M. 1984. La migration prenuptiale de trois especes de limicoles dans le marais Poitevin (Sud Vendee). *Alauda* 52: 204-220.

Harengerd,M., Pr•nte, W. & Speckmann, M. 1973. Zugphänologie und Status der Limikolen in den Rieselfeldern der Stadt Münster. *Vogelwelt* 94: 81-118, 121-146.

Heg, D. 1988. Het overwinteren van het Witgatje *Tringa ochropus* in het Rijk van Nijmegen. *Limosa* 61: 113-118.

Hötker, H. 1988. Frühjahresrastbestände des Kampfläufers (*Philomachus pugnax*). Ergebnisse der Zählung vom 1. Mai 1988. *Corax* 13: 100-105.

Imboden, C. 1974. Zug, Fremdansiedlung und Brutperiode des Kiebitzes *Vanellus vanellus* in Europa. *Orn. Beob.* 71: 5-134.

Mason, C.F. 1984. The passage of waders at an inland reservoir in Leicestershire. *Ringing & Migration* 5: 133-140.

OAG Münster 1981. Inland wader counts - first progress report. *Wader Study Group Bull.* 32: 20-23.

OAG Münster 1987. The timing of autumn migration of some wader species in inland Europe: provisional results. *Wader Study Group Bull.* 50: 7-16.

OAG Münster 1989a. Beobachtungen zur Heimzugstrategie des Kampfläufers *Philomachus pugnax. J. Orn.* 130: 175-182.

OAG Münster 1989b. Zum Wintervorkommen des Waldwasserläufers *Tringa ochropus* in den Rieselfeldern Münster. *Vogelwelt* 110: 130-142.

OAG Münster 1990. Heimzugrastbestände des Kampfläufers *Philomachus pugnax* 1989 in Niedersachsen und Bremen. *Vogelk. Ber. Nieders.* 22: 6-12.

Piersma, T. 1987. Hink, stap of sprong? Reisbeperkingen van arctische steltlopers door voedselzoeken, vetopbouw en vliegsnelheid. *Limosa* 60: 185-194.

Piersma, T., Beintema, A.J., Davidson, N.C., OAG Münster & Pienkowski, M.W. 1987. Wader migration systems in the East Atlantic. *Wader Study Group Bull.* 49, *Suppl./IWRB Spec. Publ.* 7: 35-56.

Sachs, L. 1978. *Statistische Auswertungsmethoden.* Springer Verlag, Berlin, Heidelberg, New York.

Smit, C.J. & Piersma, T. 1989. Numbers, midwinter distribution, and migration of wader populations using the East Atlantic flyway. *IWRB Special Publ.* 9: 24-63.

Troilliet, B. 1992. Repartition et effectifs hivernaux des limicoles cotiers. B.M. O.N.C. No. 169..